
FACULTY OF TECHNOLOGY

# RESILIENCE IN SUPPLIER MANAGEMENT IN ENERGY INDUSTRY

Suvi Leinonen

Supervisors: Arto Reiman, Osmo Kauppila and Kaj von Weissenberg

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# ABSTRACT

Resilience in supplier management in energy industry

Suvi Leinonen

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Supervisors at the university: Arto Reiman, Osmo Kauppila and Kaj von Weissenberg (Kiwa Inspecta)

Currently, there is variation and development need in Finnish companies how prepared and resilient they are against crisis and disruptions. In the energy industry, supply chain resilience (SCRes) is a critical part of strategic management due to its critical role in society and effect on competitiveness. Disruption effects to supply chain (SC) performance are minimized by proactive risk management and ensuring business continuity by different capabilities in buyer company and suppliers. Crisis and disruptions are not completely predictable or preventable and different capabilities ensure fast recovery from disruptions and crisis.

The aim of this research is to define how SCRes can be managed and developed by supplier relationship management in the energy industry in Finland. The research consists of a literature review and empirical study implemented as qualitative research using a semi-structured interview. The research target is achieved by research questions defined below:

RQ1: How can SCRes be defined in an energy industry context?
RQ2: How to manage SCRes?
RQ3: What capabilities are critical to be considered to ensure high SCRes in the energy industry in Finland?
RQ4: How to improve SCRes in the energy industry in Finland?

The key findings indicate that SCRes needs to be continuously assessed and improved by several intra-organizational and inter-organizational collaborative capabilities. Business Continuity Plan needs to be implemented proactively in collaboration with suppliers and

other networks. SCRes is managed through the whole SC by systematic and proactive supplier relationship management (SRM). As the research is a wide interview study, the findings of this research can be utilized for other industrial fields by management and improvement of SCRes. It needs to be considered that the findings are subjective as done by one researcher.

*Keywords: Supply Chain Resilience, energy industry, Business Continuity Management, collaboration, Supplier Relationship Management*

# TIIVISTELMÄ

Alihankkijoiden resilienssiarviointi energiateollisuudessa

Suvi Leinonen

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Työn ohjaajat yliopistolla: Arto Reiman, Osmo Kauppila ja Kaj von Weissenberg (Kiwa Inspecta)

Toimitusketjun resilienssi vaihtelee suomalaisissa yrityksissä ja siinä on kehitettävää sen mukaan, miten varautuneita ja kriisinkestäviä yritykset ovat. Energiateollisuudessa toimitusketjun resilienssi on kriittinen osa strategista johtamista yhteiskuntakriittisyyden ja kilpailukyvyn vaikutuksen vuoksi. Häiriöiden vaikutukset toimitusketjuun minimoidaan proaktiivisella riskienhallinnalla ja varmistamalla liiketoiminnan jatkuvuus erilaisilla kyvykkyyksillä. Kriisejä ja häiriöitä ei voida täysin ennustaa tai estää, joten erilaisia kyvykkyydet varmistavat nopean toipumisen kriiseistä.

Tämän diplomityön tavoite oli selvittää, miten toimitusketjun resilienssiä voidaan johtaa ja kehittää toimittajasuhteiden hallinnan kautta energiateollisuudessa Suomessa. Tutkimus koostuu kirjallisuuskatsauksesta ja empiirisestä tutkimuksesta, joka on toteutettu laadullisena tutkimuksena puolistrukturoitujen haastatteluiden avulla. Tutkimuksen tavoitteet saavutetaan seuraavilla tutkimuskysymyksillä:

TK1: Miten toimitusketjun resilienssi määritellään energiateollisuudessa?
TK2: Miten toimitusketjun resilienssiä johdetaan?
TK3: Mitkä tekijät ovat kriittisiä toimitusketjun korkean resilienssin varmistamisessa energiateollisuudessa Suomessa?
TK4: Miten toimitusketjun resilienssiä voidaan kehittää energiateollisuudessa Suomessa?

Keskeisimmät löydökset osoittavat, että toimitusketjun resilienssiä tulee parantaa jatkuvasti yritysten sisäisten kyvykkyyksien ja yritysten välisten, yhteistyöllä vahvistettavien kyvykkyyksien kautta. Liiketoiminnan jatkuvuussuunnitelma otetaan

käyttöön proaktiivisesti yhteistyössä toimittajien ja muiden sidosryhmien kanssa. Toimitusketjun resilienssiä johdetaan koko toimitusketjun matkalla systemaattisen ja proaktiivisen toimittajahallinnan kautta. Koska kyseessä on laaja haastattelututkimus, löydöksiä voidaan soveltaa myös muille teollisuuden aloille toimitusketjun resilienssin johtamiseen ja kehittämiseen. On otettava huomioon, että löydökset ovat subjektiivisia yhden tutkijan tekemiä löydöksiä.

*Asiasanat: Toimitusketjun resilienssi, energiateollisuus, liiketoiminnan jatkuvuudenhallinta, yhteistyö, toimittajasuhteiden hallinta*

# FOREWORD

This thesis is done as an assignment from the University of Oulu and the HSEQ® cluster. The work was written as research for the Degree program of Industrial Engineering and Management between November 2020 and June 2021. The thesis project has been an interesting journey into the energy industry and into the challenging subject of supply chain resilience.

I would like to thank my supervisors Arto Reiman, Osmo Kauppila and Kaj von Weissenberg for your advices, support and positive, encouraging collaboration. You challenged me in a positive way to exceed myself and leave the comfort zone. I would also like to thank HSEQ® cluster member companies, interview participants and the Kiwa Inspecta for your time and efforts for my thesis and pleasant cooperation with you. I have learned a lot during this project, and I´m looking forward to new avenues with this topic.

I would also like to thank my husband Joel and my daughter Vilja who gave me support and strength with my studies and with my thesis. I want also to thank my parents, family, grandmother and friends for their support and encouragement. Finally, I want to thank my student colleagues and lecturers for collaboration during these years. This was a memorable journey!

In Oulu 8.6.2021

*Suvi Leinonen*

Suvi Leinonen

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# ABBREVIATIONS AND DEFINITIONS

| | |
|---|---|
| BCM | Business Continuity Management |
| BCP | Business Continuity Plan |
| CAS | Complex Adaptive System |
| CI | Critical Infrastructure |
| DRP | Disaster Recovery Plan |
| ER | Energy Resilience |
| FL | Factual Level |
| KPI | Key Performance Indicator |
| LCN | Low-Certainty-Need framework |
| LFHI | Low-Frequency-High-Impact |
| LOGY | Finnish Association of Purchasing and Logistics |
| NESA | National Emergency Security Agency |
| SC | Supply Chain |
| SCRes | Supply Chain Resilience |
| SFC | Supply Chain Finance |
| SLA | Service Level Agreement |
| SRM | Supplier Relationship Management |
| VL | Value Level |

# 1 INTRODUCTION

## 1.1 Study background

There is a wide variation between companies in Finland on how prepared or resilient they are in crisis situations. In general level, Finland is considered as one of the three most resilient countries, but still, there is an urgent need to develop their organization, flexibility, preparedness and partnerships to build competitiveness and resilience for the future. (Business Finland 2021) The disruptions in supply chain (SC) are caused by different controllable and unpredictable reasons related e.g. to quality problems, financial turbulence or demand fluctuations. Those affect SC performance which can be minimized by preparing an organization proactively to face risks and react in case of disruptions. (Scholten et al. 2019) Supply chain resilience (SCRes) is defined as an essential capability to keep up the performance in case of disruptions (Christopher & Peck 2004, according to Scholten et al. 2019). Resilience needs to be part of daily operations in the companies (Business Finland 2021).

Currently, the energy industry in Finland is changing due to the decrease in fossil fuel usage and increase renewable energy. EU has a long-term strategy to be climate neutral by 2050, which is based on the European Green Deal and Paris Agreement. (EU Commission 2021) This affects SC and supplier categories remarkably, which means SCRes needs to be kept up and built with a new network in a changing environment. Energy industry SCs are more vulnerable to disruptions with continuous risk, and collaboration is needed with stakeholders to get a wide understanding of risks. (Emenike & Falcone 2020) In the global energy industry field, safety, learning and new knowledge are recognized as necessary capabilities in organizational resilience, although further research is needed on how the interaction between different organizational levels and processes can increase adaptability and thereby resilience. (Bento et al. 2021)

SCRes capabilities are defined in earlier research from different perspectives. The identified capabilities are organizational structure, collaboration, flexibility, velocity, visibility, supply network structure and resilient purchasing practices. (Isopoussu 2020). A connection between supplier relationship management (SRM) and SCRes is stated important as the SCRes capabilities can be improved by management (Shin & Park 2021).

The current literature is considering SCRes capabilities and how to consider those in SRM only in a few research. This research is needed to consider SCRes capabilities and their management in energy industry in Finland.

## 1.2 Research problem, objectives and scope

A research topic was defined based on a need from the HSEQ® cluster to consider SCRes in the energy industry. In addition to previously indicated need for academic research the practical need was identified due to ongoing Covid-19 pandemic. The target of this thesis is to define how SCRes can be managed and developed by supplier relationship management in the energy industry in Finland. SCRes research in this study covers investments, operations, maintenance and revisions in the energy industry in Finland. The research target is covered with the following research questions:

**RQ1: How can SCRes be defined in an energy industry context?**

The first research question is answered based on the literature review.

**RQ2: How to manage SCRes?**

The second research question is answered based on the literature review.

**RQ3: What capabilities are critical to be considered to ensure high SCRes in the energy industry in Finland?**

The third research question is answered based on the empirical study. The critical capabilities affecting SCRes are recognized by interviews with buyer companies and National Emergency Supply Agency. Based on these findings from interviews, needed capabilities for suppliers and buyer companies are recognized in the analysis. The practical implications for suppliers and buyer companies are introduced based on the analysis.

**RQ4: How to improve SCRes in the energy industry in Finland?**

The fourth research question is answered based on the empirical study. The activities to improve SCRes are identified by interviews in buyer companies and National Emergency Supply Agency. The practical implications are introduced for suppliers and buyer companies based on the analysis.

## 1.3 Structure of the thesis

A research process consists of six chapters (Figure 1). The background of the study, the need for the research, as well as research objectives, questions and scope are described first in an introduction chapter. The research process is also described in the introduction. In the second chapter, the literature review provides a review of SCRes and considers different capabilities when increasing resilience and its management and development. Energy industry related characters, resilience and SRM are considered in the literature review as well. Literature review synthesis is introduced at the end of the chapter, and answers to research questions RQ1 and RQ2 are provided.

An empirical study is introduced in the third chapter with research methods and the data collection process. The analyzed data from interviews is introduced in the fourth results chapter, which includes categorized findings of critical capabilities affecting on the SCRes in energy industry. The results are summarized in the synthesis at the end of the chapter and research questions RQ3 and RQ4 are partially answered.

In the discussion chapter, results from interviews and literature review are considered together to define the SCRes management practices in the energy industry in Finland. The answers to all research questions are finalized in the discussion chapter. The findings based on the results are compared to earlier research. The managerial implications are introduced based on the results and literature review. The conclusions are reviewed in chapter six, where the most important findings are introduced, and answers are given to research questions. The limitations, validity and impact, as well as future research needs, are presented at the end of the chapter.

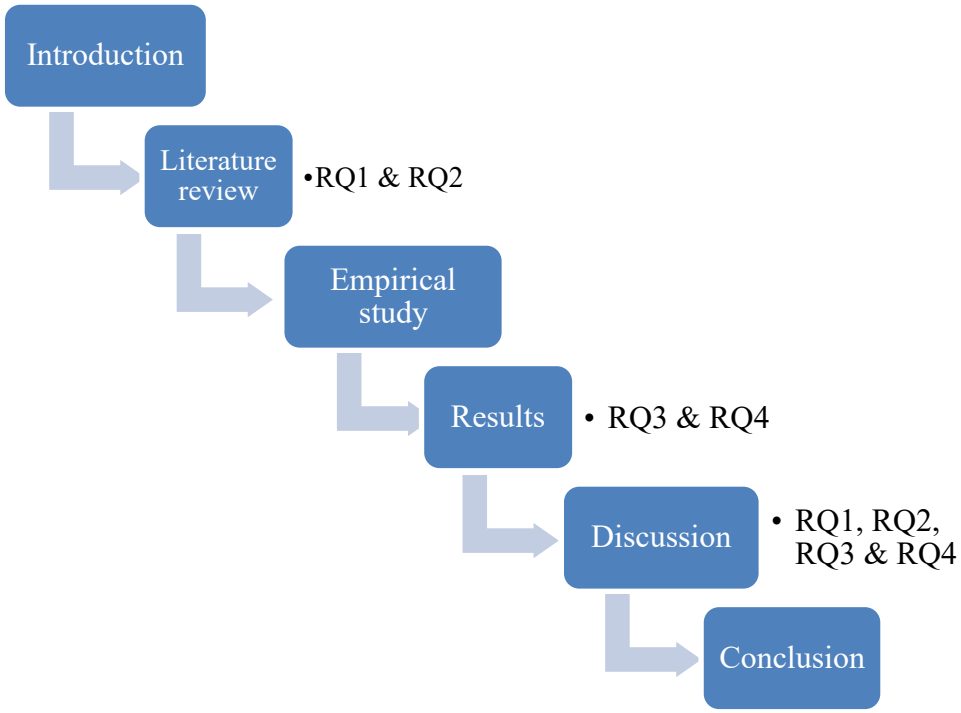


Figure 1. The research structure.

# 2 LITERATURE REVIEW

## 2.1 Supply chain resilience

Disruptions in the supply chain are common 75% of companies every year. The root causes behind disruptions vary widely from quality problems and demand changes to financial challenges, labor availability problems and weather conditions. The severity and duration of disruptions reflect to performance effects, and some of the disruptions can not be controlled or predicted. (Scholten et al. 2019) Rare events with high risk for SC are called low-frequency-high-impact events (LFHI). LFHI risks can be caused by nature causes or industry itself e.g., tsunamis, earthquakes, pandemics or explosions. (Ivanov & Ajay 2020)

Some companies are better prepared beforehand and more competent to deal with disruptions than others and as a result are better able to maintain their level of performance. Thereby SCRes is an essential tool in a company´s strategic management to ensure competitiveness in the market. When considering SCRes, several elements need to be considered. (Scholten et al. 2019) Resilience means an ability to withstand against risks, and it requires systematic planning and building. The company´s culture and its readiness, for instance, to change its operational models or strategies, is the base for resilience. Stable organization, agility and culture to identify, react and prevent risks make the organization resilient. (Business Finland 2021)

### 2.1.1 Definition of resilience

There are several definitions for resilience in the scientific literature but none of those is universally accepted. As a word, it originates from the Latin word “resilire” which means “bounce back”. It is also described as an ability to tolerate and recover and to adapt from a crisis, changing circumstances or disruptions to increase the system´s resistance. (Jesse et al. 2019) Holling (1973) first defines resilience as follows: “Resilience and stability of ecological systems: Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist.” (Holling 1973, according to Jesse et al. 2019) According to Bento et al. (2021), resilience can be defined with four principles: ability to respond to current happenings, ability to monitor and proactively identify potential problems and learn from experiences (Bento et al. 2021). Resilience can also be

defined as an outcome of identified capabilities that improve and create organizational resilience, like resources and strategies or which have a negative impact on resilience. It can also be seen as a process with anticipation, coping and adaption stages defining the process from resources to outcome. Furthermore, resilience has been defined by Bento et al. (2021) to arise from combining knowledge, competence and resources. To reach resilience, interaction between different layers in the organization is needed. (Bento et al. 2021) The research about resilience in different fields has been increasing during the last ten years continuously. This can be explained e.g. by understanding the fact that unexpected disruptions and risks will occur which requires quick ability to recover from those. (Jesse et al. 2019) Resilience can be defined as three types (Table 1) (Jesse et al. 2019).

Table 1. Resilience types.

| **Types of resilience** | **Definition** | **Source** |
|---|---|---|
| Engineering resilience | Ability to return system back to its normal balance state after crisis. The main focus is on robustness, efficiency and consistency in systems where their behavior can be predicted. | Holling (1973); Jesse et al. (2019); Holling (1996) |
| Ecological resilience | Ability of systems to reorganize itself after crisis to one of the several balance states. Defines resilience in complex adaptive systems (CAS) which are unpredictable and dynamic systems including several counterparts with the ability to develop and adapt their actions. | Molyneaux (2016); Jesse et al. (2019) |
| Adaptive resilience | Ability of system to adapt stress, learn and self-organize. The system changes and adapts to the new balance state after a crisis. | Simmie J, (2010); Jesse et al. (2019) |

According to Adobor (2020) resilience can also be considered as an evolutionary resilience through an adaptive cycle concept. The adaptive cycle concept considers SCRes as changing, adaptive and transforming. The adaptive cycle describes a system´s ability to recover, reorganize, to adapt to change and to create new. (Gunderson and Holling 2002) SCRes can be managed more proactively and strategically when each stage of the adaptive cycle is known. Disruptions are seen as possibilities for renewal, strengthening the SCRes. (Adobor 2020) The key properties in the adaptive cycle are potential, connectedness and adaptive capacity. Potential includes economic and social capital which are the available resources in the system to be used for change. Connectedness describes the linkage between different counterparts in SC. Adaptive

capacity considers a system´s vulnerability and the ability to deal with it. Through adaptive cycles, it is possible to get visibility to continuous transformation and thereby build a resilient system through it. (Adobor 2020) A resilient system can keep up its performance at the level by changing its mode of operations in case of internal or external disruptions. The core activities in the system have an important role when building the resilience. (Bento et al. 2021; Holling 1973) Instead of bureaucracy and limitations, resilience can be reached by continuous monitoring of current performance, risk-aware and robust processes (Bento et al. 2021). The difference between resilience and sustainability can also be analyzed. Sustainability concentrates on preserving current structures or functions. It considers the social, economic and environmental elements how they build the life quality and its continuity for the future and in long-term perspective. (Jesse et al. 2019)

### 2.1.2 SCRes management

Building resilience requires systematic and proactive work in risk management through the SC processes and in co-operation with suppliers and other stakeholders. It needs to be built in teams, individual and organizational level, as well as through the SC network and on the national level. (Scholten et al. 2019) The companies have strengthened their SC in different ways e.g. by developing real-time follow-up and visibility systems, by developing allocation practices to balance supply and demand, and by creating backup plans for supply and delivery plans. (Ivanov & Ajay 2020) Partnerships, capabilities and resources to handle crises need to be built beforehand to prepare for a possible upcoming crisis. Visible and solution-oriented cooperation with partners enables survivors from the crisis. Product development creates the base building resilience and there need to be alternatives to choose suppliers and components. It is stated that the safety inventory can support at the beginning of disruption. It needs to be notified that the epidemic will affect globally and back up suppliers are affected. (Ivanov & Ajay 2020) When a crisis occurs, it is necessary to react immediately. Business Continuity Plan (BCP) ensures continuity and agility to react in a changing environment. (Business Finland 2021)

SCRes needs to be considered much comprehensively than only from the organizational level since it is depending on the entire SC and resilience of each counterpart in the chain. SCRes management requires a wide look into the big picture of all companies and SCs in general industry, national or supranational level. (Scholten et al. 2019) Resilience needs to be considered when creating the business strategy as it needs to enable agile, flexible

decision making and actions in the company. It is essential to understand which risks and opportunities can occur in a crisis. It is also necessary to understand the meaning of finance, partnerships and possibilities to grow business. (Business Finland 2021)

In governance, several elements need to be considered. In planning the scenarios and their financial effects are necessary to be considered. Customer demand in the future improves solvency which is essential for the company. Products need to be planned as resilient against crisis which means standard components and various suppliers. To ensure business agility, a business plan needs to be reviewed regularly. (Business Finland 2021) When scenarios are clarified, it enables agility in strategy work. Decentralization in products or markets shares risks. Risks need to be considered in costs and their effect evaluated in budgeting to identify the most effective risks and categorize the actions against them. From the risk management perspective it is necessary to learn and enable renewal from crisis and include risk management as part of management and decision making. (Business Finland 2021) SCRes can be improved e.g., by considering vendor managed inventory and correct location in the chain. According to Scholten et al. (2019), it is stated that SCRes depends on the final counterparts of SC and their ability to solve problems in the chain. It is stated that dynamics between organizations can create flexibility, collaboration and readiness to build resilience at the country or industry level. The importance of information flow is highlighted to increase risk awareness and adaptability. From a competence development and knowledge sharing perspective, the co-operation between the whole chain is essential. (Scholten et al. 2019)

It is stated by Rajesh (2020) that flexible strategies promote resilience building. However, SC complexity needs to be reduced at the same time. Flexibility can be reached by multiple supplier strategy. Single sourcing is seen as a risk even if there are advantages from the collaboration with suppliers. (Kirilmaz & Erol 2017) In multiple sourcing it is possible to define main suppliers and alternative suppliers for those. (Rajesh 2020). It is necessary to cooperate with suppliers and most essential customers when ramping up the production to optimize the usage of resources most efficiently way. When considering demand and supply, it is necessary to understand risks and develop the operations. Decentralization of critical procurement´s suppliers decreases the risks. The role of partnerships and confidence is essential, which need to be considered while decentralization. Decentralization of decision making to local decision making and sharing best practices gives better possibilities to local control. Abilities to work remotely

using digital systems minimize the business effects in case of a crisis. It is necessary to be aware of restrictions by law and the possibilities to change the production locations from one location to another. (Business Finland 2021)

The partnerships are necessary in case of crisis. Resilience is increased through cooperation and communication with other companies and stakeholders. It is necessary to understand crisis effects, find solutions, communicate effectively and share best practices with customers and partners. It is necessary to share information about risk awareness and preparedness. It is also recommended to establish the national crisis committee with members from different companies. (Business Finland 2021) According to Azadegan and Dooley (2020), there are different kinds of collaboration linked to resilience strategies. Micro-level resilience is created between buyer and supplier in risk prevention and recovery planning. Macro-level resilience is considering supply risks in the long term, and it is created in collaboration between corporations and institutions. Meso-level resilience is created in multiple supply network, and it considers supply risks in the short and medium term. (Azademan & Dooley 2021) The risks in supplier network can be reduced by using a stakeholder engagement plan which collects the whole supply network digitally together in the same digital platform. It is important to include the entire SC to get the information about the risks and weakness points in the whole chain. (Business Finland 2021)

### 2.1.3 Organizational resilience

There are three different definitions of organizational resilience. Resilience as an outcome targets to strengthen organizational resilience by identifying the needed features like resources, strategies and behaviors, as well as elements that have a negative or positive impact on resilience. Resilience as a process targets to identify stages of resilience from a time perspective, including anticipation, coping and adaptation. Resilience capabilities consider abilities in an organization to keep up resilience. (Bento et al. 2021) According to Kamalahmadi et al. (2016), organizational resilience is considered as an organization´s dynamic capacity to adapt and respond to changes by highlighting its abilities (Kamalahmadi et al. 2016). Dynamic capabilities are necessary to promote problem solving continuously and to find new business opportunities in the company (Pitelis & Teece 2010; Teece 2012; Kindström, Kowalkowski, & Sandberg 2013, according to Sabahi & Parast 2019). Dynamic capabilities minimize risks by creating new resources and capabilities (Barreto 2010; Stefano, Peteraf & Verona 2010, according to Sabahi &

Parast 2019). The organization is dependent on the individuals, groups and resilient subsystems (Kamalahmadi et al. 2016). The organization can build resilience by focusing on differentiation or by a willingness to change (Flint et al. 2011). To be able to build resilience, co-operation between companies is needed (Scholten & Schilder 2015; Werner et al. 2020).

In a resilient organization, employees are encouraged to learn from mistakes and learn new roles flexibly. Multi-skilled employees and open culture in a company are key components in building the resilience. Employees need to be included to participate in strategic work and the atmosphere needs to support open discussions with their own opinions. The employees need to have cross-competence to be able to work in different tasks and positions. Communication and continuous discussion are necessary between management and employees as well as between risk department and managers in different departments. Employees need to be motivated and clearly instructed by skilled managers to ensure common efforts to reach high resilience. (Business Finland 2021) Social capital and networks have an important role in SCRes and recovery from disruptions. Social capital means extra resources and value created by external social networks to companies. It has been identified to be an important factor when adapting to changes and recovering from them. It is stated that social capital exploits information and knowledge exchange between reference companies and the organization's ability to absorb it, and to build trust between counterparts. According to Gölgeci and Kuivalainen the new potential can be found via social capital to strengthen the resilience. (Gölgeci & Kuivalainen, 2020)

It is stated that individuals and teams have an essential role as decision-makers in building SCRes. Thereby the elements in human resources management and internal social capital are in key role and in committing and respecting the target to build SCRes. Visibility in processes and creating routines are the way to build resilience iat an organizational level. It means developing capabilities in co-operation with their suppliers. It needs to be notified that the capability development requires resources and thereby small companies have lesser possibilities to develop than larger ones. (Scholten et al. 2019)

It is stated that effective information sharing improves the company´s resilience (Datta, Christopher & Allen 2007; Soni, Jain & Kumar 2014, according to Sabahi & Parast 2019). Company´s ability to manage disruptions beforehand, throughout and afterward is improved by knowledge sharing (Soni & Jain 2011, according to Sabahi & Parast 2019).

According to Mandal (2012, according to Sabahi & Parast 2019) effective information sharing is necessary to the collaboration. It is also stated by Melnyk et al. (2014, according to Sabahi & Parast 2019) that potential risks can be more effectively identified when information is effectively shared. Information and knowledge sharing can be supported by innovations in SC processes (Kwak, Seo & Mason 2018, according to Sabahi & Parast 2019).

According to Sabahi and Parast (2019), innovativeness support companies to strengthen their capabilities and thereby resilience against disruptions. It has been stated that sufficient resourcing for innovation supports companies to adapt their operations to changes and recover from disruptions. Innovative companies are more agile and adaptable to changes since they have the capability to seek and find new solutions. According to Sabahi & Parast (2019) knowledge sharing, agility and flexibility are the most important elements when building resilience. Innovations are promoting knowledge sharing, agility and flexibility. When innovation capability is improved resilience will increase in the company. (Sabahi & Parast 2019). Innovations create value and new capabilities (Teece 2007; Ellonen, Wikström & Jantunen 2009, according to Sabahi & Parast 2019). They are needed to keep up the company´s ability to adapt and change their products or way to operate (Christopher 2005; Kim, Choi & Skilton 2015, according to Sabahi & Parast 2019). In addition to performance improvement SC innovations improve risk management capabilities and resilience (Kwak, Seo & Mason 2018, according to Sabahi & Parast 2019).

When considering resilience improvement agility is the most necessary factor. (Sullivan-Taylor & Branicki 2011, according to Sabahi & Parast 2019). Innovations are needed to keep up the competitiveness in changing environment (Rud 2009, according to Sabahi & Parast 2019) and the agility can be improved by innovations (Esterhuizen, Schutte & Toit 2012, according to Sabahi & Parast 2019). It is stated that when the company is using innovative strategies in information sharing it can react to market changes more effectively (Hult, Ketchen Jr & Slater 2005, according to Sabahi & Parast 2019). Innovations have significant effect on flexibility (Bock et al. 2012, according to Sabahi & Parast 2019) and for instance operational flexibility can be reached by innovative logistics processes (Grawe, Daugherty & Roath 2011, according to Sabahi & Parast 2019). A flexible organization enables innovations creation and implementation to solve disruptions more effectively (Lau 1996, according to Sabahi & Parast 2019).

### 2.1.4 Financial resilience

SC finance (SFC) improves stability in SC by reducing costs and financial risks which increase competitive advantage (Tate et al. 2019). According to Jia et al. (2019), SC financial performance can be effectively improved to be more sustainable by using SFC methods and thereby minimize negative impacts (Jia et al. 2019).

> *SC finance is an approach for two or more organizations in a SC, including external service providers, to jointly create value on an inter-organizational level through means of planning, steering and controlling the flow of financial resources (Tate et al. 2019).*

SFC commits customers and suppliers to share risks and the value of financial flow. SCF e.g. enables effective financial processes, increases commitment and profitability, as well as reduces working capital and risks through the SC. SC financial management can be done from two perspectives. It is done in the short-term when the focus is to get the best results for the individual company. The second perspective is focusing on the working capital optimization through the whole SC. It is stated that the companies need to pay attention to whole SC cash flow to be able to manage risks, supplier relations and total cost perspective. (Tate et al. 2019) It is stated that poor financial management is decreasing efficiency in SC and weakening finance on the suppliers´ and buyers´ sides. (More & Basu 2013; Jia et al. 2019). According to Zhao et al. (2018) building profitability by good coordination is the key to create sustainable SC (Zhao et al. 2018). SFC solutions are promoting innovations and sustainability in SC as well as collaboration in SC, which improves sustainability. (Silvestre 2015; Jia et al. 2019).

### 2.1.5 Supply chain risk management

SCRes is a tool for SC risk management (Adobor 2020). According to Ivanov et al. (2020), in case of a pandemic the actions need to be done reactively in real-time. Proactive management and product availability follow-up in the supply network are essential (Ivanov et al. 2020). Resilience can be increased by modelling the optional scenarios and preparing the plans according to them. This helps to anticipate risks but also the opportunities. Risk-related early warning signs can be identified, and those can be based on information from suppliers, for instance, or other technical information. It is necessary to react immediately when the risk occurs. A company needs to have a beforehand agreed

crisis committee consisting of participants from different teams. Documentation enables the ability to operate and minimize the dependency of certain employees. (Business Finland 2021)

It is also stated that the SCRes can be increased by creating a low-certainty-need framework (LCN) including e.g., a detection system for capacity and inventories as well as risk management plans. It is stated that SC can be planned to use local suppliers for about 10-20% of supply volume, which can be increased in crisis up to 70-80%. The second option is to plan an offline supply base when the local supply could be planned virtually without any business share to create the readiness for SC re-design in case of global crisis. These options need to be considered in capacity flexibility and product diversification perspective to enable e.g., quick manufacturing technology changes. (Ivanov et al. 2020) According to Adobor (2020), there is still a need to improve dynamics in SC and increase complex adaptive system thinking, which increases the understanding of systems behavior and root causes behind the changes. The adaptive cycle concept supports the identification of strengths in SC that need to be maintained. (Adobor 2020)

### 2.1.6 Resilience performance measurement

According to Werner et al. (2020) Key Performance Indicators (KPIs) are used to monitor and manage processes to reach the targets. They consider the processes from a quantifiable perspective. It has been stated that the used KPIs depend on the company strategy, and there is variation between used KPIs in the companies to measure resilience. KPIs have an essential role in proactive risk management and effect mitigation of unexpected disruptions. By usage of KPIs, the abnormalities and current state in SC can be identified. (Werner et al. 2020). According to Singh et al. (2019), increasing resilience requires several actions to enable evaluation of the current level and implement development strategies. The key operational processes need to be defined, strategic objectives set and used KPIs defined. When capabilities are developed to improve resilience in SC, it will enable the reaching of strategic objectives as well. (Singh et al. 2019)

According to Shokoohyar and Katok (2021), supplier performance can be evaluated using a supplier scorecard. The used indicators and weight for each of those are defined in the supplier scorecard. The usage of supplier scorecards is promoting the desirable behavior of suppliers. (Shokoohyar & Katok 2021) Supplier quality monitoring includes financial

conditions, accuracy in SC, delivery quality and management process, and it helps to identify development needs. It is important that the information about supplier behavior is available for the different functions in the company, for instance quality and manufacturing, to promote collaboration (Christopher 2004). When collaboration is increased, it will increase organizations' ability to adapt in case of crisis, and flexibility in the organization (Christopher 2004; Pettit et al. 2013). It is stated by Werner et al. (2020) that supplier quality follow-up is important as it provides a strong base for actions to increase and build resilience. Suppliers' quality monitoring provides a better understanding of supplier capabilities and promotes joint strategic work with suppliers, which supports the stability of operations. Thereby supplier quality follows up increases collaboration, flexibility, visibility, knowledge management, information sharing, risk management and safety which are the elements when building resilience in the organization. (Werner et al. 2020) Product quality monitoring provides information about compliance and quality of delivered products based on the agreed quality definitions with the supplier. Information about the root causes of defects and location in SC can be identified. Quality problems can be identified, and corrective actions can bedone by following scrap rates. (Werner et al. 2020)

According to van Weele (2010), suppliers´ financial state can be assessed based on annual financial reports, which includes several financial indicators to evaluate profitability, equity and cash management. For instance, a profitability ratio from operational profit and net capital employed can be used. Ration from cash flow and investments can be used to as an indicator to evaluate the equity relationship. Cash management can be evaluated by following average payment terms to creditors. In addition to follow-up of history data, it is recommended to implement financial forecasting practice to identify opportunities and threats in the future. (van Weele 2010, p. 357-358) In performance also measuring economic losses and gains, external impact and recovery time can be used as metrics (Emenike & Falcone 2020).

### 2.1.7 Business continuity management

There are several definitions for business continuity management (BCM). Gibb et al. (2006) define BCM as a process to identify and manage risks related to necessary processes and services by effect mitigation to ensure recovery from disruption and minimal effects by disruption (Gibb et al. 2006; Sawalha 2020). BCM includes all proactive actions done in the company to manage operational disruptions, and it ensures

that there are core services are available for the society. Continuity management needs to be a continuous activity in a company. Nowadays, there are several operators in a product and service SC. Improvement actions in operational continuity affect the whole SC by increasing reliability and security of supply. The role of the continuity management process in an organization is to identify business threats, disruptions and dependencies, evaluate the threat effects in the whole SC and prepare and organize procedures in case of crisis. It also ensures that critical partners have abilities to operate in crisis and protects business interests and capability to create value. (NESA 2020)

Engemann (2018, according to Groenendaal & Helsloot 2020) has stated that BCM is based on the management of the predictable, familiar and quantifiable risks (Engemann 2018, according to Groenendaal & Helsloot 2020). It has been noted that BCM is not suitable to manage unpredictable, largely affecting events that are not quantifiable (Taleb 2005, according to Groenendaal & Helsloot 2020). Such unpredictable events, for instance, have been current Covid-19 pandemic and the September 11$^{th}$ attacks in 2001. (Groenendaal & Helsloot 2020). According to NESA (2021), continuity management with proactive continuous improvement can reduce costs and damages caused by disruptions are minimized. It also improves the abilities of a responsible person to operate in exceptional situations and increases co-operation. Recovery from disruptions is faster when continuity management is in place. The whole SC needs to be considered in continuity management to ensure operational ability in the whole SC in crisis. (NESA 2020)

**Business Continuity Plan**

According to Hatton et al. (2016) Business Continuity Plan (BCP) creates the base for risk management in the company (Hatton et al. 2018). It has been stated by Luskova and Leitner (2020) that BCP is necessary to be considered in critical infrastructure (CI), like the energy industry to secure the core operational processes in case of disruptions in SC. (Luskova & Leitner 2020).

It is stated by Fani and Subriadi (2019) that there is a lack of BCPs in many companies. BCP is based on the company´s needs, and, therefore, the BCP is always planned uniquely for the individual company (Snedaker & Rima 2014, according to Fani & Subriadi 2019). BCP enables normal business operations by enabling the understanding of the possible crisis effects on business and to minimize risks´ effects (Krell 2006, according to Fani &

Subriadi 2019). According to Fani and Subriadi (2019), BCP includes nine phases which consists of several activities (Table 2). It clarifies the importance of BCP and its understanding in the whole company. To ensure careful preparation and implementation of BCP, it requires participation and resources from different levels in the company, as well as costs and time. Therefore, budgeting needs to be part of BCP creation to be able to ensure needed resources and estimate the costs. (Fani & Subriadi 2019).

Table 2. BCP Framework (adapted from Fani & Subriadi 2019).

| BCP Phase | Content |
|---|---|
| **1. Determination of business continuity management needs** | Defining the objectives and scope<br>Establishing a committee and defining committee responsibilities<br>Defining related parties and resources<br>Creating communication flow |
| **2. Budgeting** | Defining resources, time etc. other cost-effective elements<br>Creating cost calculations and budget plans |
| **3. Risk analysis** | Documenting, analyzing and evaluating risks |
| **4. Business impact analysis** | Identifying, documenting and prioritizing business functions<br>Collecting IT data from processes<br>Defining disturbance tolerances<br>Analyzing disturbance impacts<br>Defining recovery times |
| **5. Business continuity strategy** | Defining preventive, action, recovery and corrective strategies |
| **6. Disaster Recovery Plan DRP** | Documenting information |
| **7. Employee trainings** | Defining training requirements<br>Defining trainings<br>Implementing trainings |
| **8. BCP testing** | Creating testing practice<br>Testing<br>Documenting findings and testing results |
| **9. Business continuity review** | Defining review period<br>Defining review mechanism<br>Implementing periodic review<br>Planning review and update |

## National Emergency Supply Agency

In Finland, security of supply maintenance, development planning and operations are managed by National Emergency Supply Agency (NESA; In Finnish Huoltovarmuuskeskus). Operations in NESA are based on the security of supply fund. It is managing and promoting the cooperation between government administration and business community to ensure secure of the supply. NESA is also responsible for ensuring critical system functionality by planning and investing in different backup systems as well as conditions required in material and service production in exceptional situations. NESA

is also responsible for obligation and emergency inventories, for instance, in case of availability problems in imported fuel. Emergency storages are maintained by NESA to secure the energy supply. The security of supply is challenged by several elements in Finland. For instance, location, cold weather and long distances need to be considered in the security of supply. To fulfill the company's business needs and requirements by laws in state and municipalities, NESA is promoting cooperation with the counterparts. (NESA 2020)

It is stated by National Emergency Supply Agency (2020) that the Covid-19 pandemic has caused changes to the security of supply. The importance of predictive and proactive preparedness is seen as essential since the operations can´t be based on lessons learned operations. The investment in resilience to develop abilities to predict and recover from a crisis is seen as important. Agility and adaptability are the key capabilities to ensure success. (NESA 2020)

SOPIVA-clauses have been created for companies to ensure business continuity in the companies and to improve the performance through the whole SC. Recommendations are tool for companies to develop their security of supply and thereby its financial results. SOPIVA-clauses include 28 recommendations regarding management, operational control, personnel and human resource management and partnerships. (NESA 2020)

### 2.1.8 SCRes development

It is stated that resilience, business flexibility and ability to recover can be increased by several elements. The increase can be reached by good governance, resource and strategic management as well as in supply and demand management, operating methods, customer and SRM. In business development resilience is necessary to be considered at every business level. For instance, flexibility improvement in customer segments, production strategy, SC, culture and product or service range will increase resilience. It is also necessary to build confidence beforehand with most essential customers, partners and financiers, as well as with the employees. (Business Finland 2021) According to Schulte et al. (2020) there are several elements affecting on the future scenarios about future work. Technology usage will increase, but for instance changes in workforce demographics, climate change, economics, sustainability and pandemics are mentioned as essential elements to be considered in future work (Schulte et al. 2020).

According to Caruso (2018, according to Schulte et al. 2020), currently, employees don´t have a responsibility to make decisions independently or work creatively in their work. Qureshi and Syed (2014, according to Schulte et al. 2020) state that there will be increase in usage of robotics due to employee costs and availability. When human-robot workplaces increase, it requires interaction, co-operation and trust between humans and robots, which means the human elements need to be considered (Koppenborg et al. 2017, according to Schulte et al. 2020).

According to Sheffi (2021), resilience and flexibility are needed to be able to react to changes in markets and crisis situations just-in-time. He also states that Toyota Production System (TPS) supports resilience by enabling Just-In-Time in SC (Sheffi 2021). Minimizing inventories creates the ability to respond better in changes of demand, react faster and in early phase in quality defects, and minimize waste and bottlenecks. (Sheffi 2021) According to Cordon and Schwarz (2021), there is an era of new normal in SC due to different crises during recent years and the latest Covid-19 pandemics. Cordon and Schwarz (2021) highlight that the lessons learned from Covid-19 are to improve flexibility and documentation of risk management, as well as follow-up business partners and their financial results. It is also necessary to be aware of the dependencies and threats of business partners. It is essential to take care of business and its reputation and protect the revenues and sustainability. (Cordon & Schwarz 2021) For instance, the latest Covid-19 pandemics and 9/11 have proved that SCs are vulnerable and failures occurred in SCs. Pandemic has fastened the development of, for instance, systems visibility and cloud service usage. (Sheffi 2021)

## 2.2 Energy industry

SCs in the energy industry are more complicated and vulnerable compared to other SCs. They consist of a supply network, production, transport, inventories and the final consumer. Energy availability through stress-tolerant and resilient SC is necessary to ensure energy security and sustained economic growth. A typical energy SC is complex and there can be different operators and owners in pipelines, processing plants and storages etc. (Emenike & Falcone 2020) Resilience relates to several factors when considering organizational perspectives in the oil and gas industry. There are internal and internal elements, like risks and complexity concerning oil production and safety issues

affecting on resilience. Variation in prices and cycles is typical for the oil and gas industry. (Bento et al. 2021)

Disruptions can be caused e.g. by infrastructure breakdowns, energy demand variations and weather conditions. Proactivity to prevent disruptions will save costs. When considering SCRes in the energy sector, it is stated that uncertainty is a more significant problem instead of disruptions, and it is essential to understand these elements to optimize SC. SCRes maintenance in the energy industry and its importance in strategic management have had more attention due to the Covid-19 pandemic. It has been notified that there is a continuous risk for disruption in the energy sector and that the risks for potential disruptions need to be understood widely. In addition to SC sustainability strategies and optimization, risk identification requires close co-operation and smooth information flow between the stakeholders. (Emenike & Falcone 2020) According to Bento et al. (2021), resilience and safety are linked together, and resilience affects safety in the oil and gas industry. It is also stated that resilience can be increased by training personnel to face unexpected crises and ensuring there are competent people in the positions. It is important to understand the information flow and management practices that support the adaptation and learning in case of pandemics, market fluctuations or workforce challenges. (Bento et al. 2021)

Due to climate change, the trend in the energy industry is to increase the renewable energy usage in energy systems and produce energy in more efficient ways with high resilience. (Jesse et al. 2019) Currently, there is a need to increase the usage of renewable resources, which requires adaptability. Covid-19 has also shown the need for processes that are able to adapt and recover from the crisis. (Bento et al. 2021)

In the energy sector, resilience is defined as created capacity to tolerate disturbances by fast recovery or alternative methods in case of disruptions in energy flow. It is stated that resilience is needed in the future due to fluctuations in economics, changes in demographics and pandemics. In the future there will be a lack of foreign employees and a loss of experiential knowledge, which requires adapting and learning new things. Preparations for this kind of situations need to be done proactively from a resilience perspective to ensure safety. It needs to be notified when the usage of renewable resources is increased the adaptive capabilities are needed since new challenges will occur. (Bento et al. 2021) According to Bento et al. (2021), the safety is the most important factor when

considering resilience in the oil and gas industry. The ability to learn and create new information in case of unexpected situation is also necessary. (Bento et al. 2021)

### 2.2.1 Characters of energy supply

The role of energy supply is to ensure energy availability without disruptions in disturbance and exceptional circumstances. The energy supply is developing new ways to maintain the security of supply and to prepare contingency. There need to be a continuous balance in electricity production and consumption and in high demand the electricity import is inevitable. Energy authority follows up the adequacy of electricity generation. Security of supply center is responsible for organizing the fuel safety storage and issues related to it. There are also several laws controlling the security of supply. In energy supply the planning is necessary. The availability of production capability in Nordic, fuel supply performance and availability of fuel import and distribution centers are critical issues in planning. In energy supply securing the self-sufficiency of domestic electricity generation is the priority. In addition there is also international cooperation for instance obligations to maintain minimum inventories of crude oil in the EU. (NESA 2021)

In Finland, the need for heating energy is highest in the world, and the energy need in industry is high. To ensure energy availability, there is import energy inventory for five months of energy consumption. (NESA 2021) District heating is the most common heating mode in Finland. The main sources of energy are wood and turf. About 70% of energy is supplied from domestic energy sources. The target is to produce carbon neutral heating energy by reducing fossil fuels and increase the usage of renewable energy sources. Coal, natural gas, oil and turf are considered as fossil energy sources (Statistics Finland 2021). In 2019 the share of the fossil energy sources was about 32% of total energy consumption in Finland. It consists of 7% coal, 5% natural gas, 23% oil and 4% turf. (Motiva 2021) It is stated that about 30% of the district heating energy is produced from wood and biomasses. In the future also usage of solar heat and geothermal heat can provide new opportunities. (Finnish Energy 2021) Hydroelectric has an important role in electricity systems in Finland as the usage of renewable energy production increases, and predictable and adjustable energy source is needed as well. Due to weather conditions, it is not possible to prevent all disruptions in energy distribution in Finland, and therefore emergency service is available. Energy supply is decentralized in Finland, which means decentralized energy production, versatile energy sources and reliable transmission and

distribution system. Renewable domestic resources of energy imported fuel and nuclear power are the main sources of electricity. (NESA 2021)

In 2019 over 80% of the electricity was produced by renewable energy sources or nuclear energy. The target is to increase usage of these energy sources further to reduce carbon dioxide emissions and to reach independence in electricity production. Finland is producing almost 40% of electricity by combined production. In combined heat and electricity production, the waste heat from the energy production process is recovered to use in district heating or in industry. Combined production decreases emissions by about 50% compared to separate production of electricity and enables the increase of renewable energy sources. (Finnish Energy 2021) Nuclear energy is the most significant energy source in electricity generation, and its share was about 30% from total electricity production in Finland in 2019. Over 20 % of the used electricity is imported, and there is a need to increase domestic, emission-free electricity production. The benefit of nuclear energy is supply safety which is the priority in nuclear power plants. (Finnish Energy 2021). The share of nuclear energy in the total energy consumption in Finland was 18% in 2019 (Motiva 2021).

Solar, wind, water, bioenergy, geothermal heat and energy from tides are considered renewable energy sources. In addition, bioenergy includes wood-based fuels, biomasses, biogas and biodegradable parts from recycled fuels. Energy policies and the use of the renewable energy sources in Finland need to be defined based on the directives and decisions by the EU. The target is to increase the usage of the renewable energy usage over 50% of final energy consumption in the 2020s. (Motiva 2021) In 2019 the usage of renewable energy sources covered 38% of total energy consumption (Statistics Finland 2021).

The oil and gas industries are complex and risk-potential fields of the energy industry where safety is a major concern. In addition, the raw material price, as well as political pressure to enlarge portfolio to renewable resources, is increasing. To improve resilience, it is important to be able to prepare for unexpected situations by learning and creating new knowledge. (Bento et al. 2021) According to Finnish Energy (2021), the change from old-style coal-fired power plants to the usage of renewable energy in electricity production requires that the electricity transmission network needs to be developed with the renewable energy production. To ensure the availability of an electricity transmission

network, the long-term planning needs to be done for the future due to long construction times and costs. (Finnish Energy 2021)

### 2.2.2 Energy resilience

When considering resilience in the energy industry, it can be seen as an enlargement of safety. The risks for disruptions in the energy industry are increasing in the future e.g. due to climate changes and variation in the power supply of renewable energy sources. All the risks can´t be proactively prevented because of the high costs, and therefore it is important to build a resilient system that can recover fast from the disruptions. Resilience has been notified as essential to be considered in energy systems. (Jesse et al. 2019) According to Emenike and Falcone (2020), there are several strategies to achieve resilience. Mitigation strategy concentrates on proactivity and prepares for disruption e.g. by addition production and supply network and increasing inventories. Recovery strategy targets to restore SC e.g. by finding the optimal technique to restore systems back to normal. In passive acceptance no actions are done beforehand or in disruption situation. The used strategies are decided based on the company priorities but also by comparing the used costs and gained benefit. (Emenike & Falcone 2020)

According to Erker et al. (2017, according to Jesse et al. 2019), energy resilience needs to be understood as a proactive and adaptive perspective. When considering ecological resilience in the energy industry the preparations before the disruptions and recovery from the disruptions need to be highlighted. Adaptation and transformation are also important in energy resilience. Erker divides resilience into three phases: preservation, re-stabilization and transformation. In energy systems, the level of vulnerability, adaptive capacity and behavior of the system depends on the duration of the crisis. Generally, long disruptions mean more serious failures than short ones except for nuclear disasters. Energy systems are complex since there are several uncertainties and possibilities for changes. (Erker et al. 2017, according to Jesse et al. 2019) Erker et al. (2017, according to Jesse et al. 2019) divided resilience also into a factual level (FL) and value level (VL). The factual level is an objective definition of reality about energy production and distribution, energy sources and demand of energy. Value level is a subjective definition of values, beliefs and attitudes. Erker also defines resilience in four principles including process-related principles, like learning ability, and substantial principles, like efficiency, redundancy and diversity. (Erker et al. 2017, according to Jesse et al. 2019).

Erker et al. (2017, according to Jesse et al. 2019) have developed a multistage process to define the energy resilience in a certain region. The process considers heterogeneous energy production and consumption data in a certain area and assess it in factual and value level. Indicators and resilience performance, as well as the compatibility of facts and values, are evaluated. Through this process, the issues affecting to resilience can be identified. The process requires qualitative and quantitative data. (Erker et al. 2017, according to Jesse et al. 2019). Binder et al. (2017, according to Jesse et al. 2019) define resilience by energy system transition by dividing energy systems into social and technical parts. Resilience is seen as a function to create diversity and connectivity. The social part considers the social connectivity, and the technical part defines diversity through different techniques. Those are elements that make it possible to reach high resilience in energy system transitions. (Binder et al. 2017, according to Jesse et al. 2019) In summary when considering ecological resilience, both technical and social perspectives need to be considered to be able to include learning and adaptive capacity into consideration. (Jesse et al. 2019)

When considering the energy systems from an engineering resilience perspective, the robustness and redundancy are necessary elements to proactively prevent disruptions. According to Afgan and Veziroglu (2012), resilience in energy systems is defined as the ability to keep up the required performance level despite of the failures. According to them, the sustainability index can be defined by combining economic, ecological, technical and social elements. They state that the resilience is the returning time between disruption and its balance state. (Afgan & Veziroglu 2012, according to Jesse et al. 2019) According to Hughes (2015), there are three criteria related to resilience that need to be fulfilled by energy systems: accessibility, affordability and acceptance. If any of those can not be fulfilled, the system is disturbed and the target is to return to its original balance state which is defined as resilience. If the system disturbance leads into a new balanced state, it is defined as adaptability. Also, Hughes states that the resilience can be measured from the time taken to recover from disruption to a balance state. (Hughes 2015, according to Jesse et al. 2019)

## 2.3 Supplier Relationship Management

SRM is providing numerous benefits for the buyer company and suppliers. Transparency is increased between supplier and company, risk mitigation and quality are improved, as

well as trust and knowledge sharing increased. Those are enabled by interaction through the whole organization, communication and effective management to add value in the long-term. (Ruuskanen 2021) It is stated by Turnbull-Smith (2021) that suppliers´ performance impact to company´s performance, and therefore SRM and performance measurement are essential. According to Ruuskanen (2021), SRM is necessary to be considered through the organization as value is created at every organizational level.

When considering performance improvement, collaboration is necessary. Turnbull-Smith (2021) highlighted the interaction, feedback, dialogue, communication and information sharing with suppliers and stakeholders about gained results improve collaboration and continuous improvement. It was considered crucial that regular meetings are preferred to be arranged with critical suppliers monthly. By common business practices and targets common awareness and collaboration can be increased. (Turnbull-Smith 2021) It is defined by Ruuskanen (2021) that clear responsibilities and ownerships in SRM as well as management practices are needed to be able to add value through SRM.

### 2.3.1 Purchase order specifications

The purchasing process is defined based on the business needs and requirements. To prevent unclarities in the next phases in the purchase process specification phase is needed. Phases in the process are specification definition, supplier selection, making agreement, order practice implementation, expediting routine implementation and supplier assessment. The specification phase is the first step in purchasing process when requirements for purchasing are defined. Purchase order specification consists of several specifications and requirements. The functional specifications define needed functionalities and technical specifications regarding product properties and actions done by the supplier. In addition, there are quality, logistics, maintenance and legal specifications as well as environmental requirements and target budget defined. (van Weele 2010, p. 28-29; 32-33)

Procurement in certain fields is regulated by laws. Laws defining the procurement in the energy industry in Finland are Act on Public Procurement and Concession Contracts (1397/2016) and Act on Procurement and Concession Contracts licensing of entities operating in the water, energy, transport and postal service (1398/2016). It is defined by laws that tendering needs to be done in procurement. The targets of laws are to promote the quality and innovativeness in procurement and ensure that every company has equal

opportunities to offer their products or services. Laws are also targeting to implement procurement activities economically and systematically with high quality. Laws are defining the tendering process, procurement procedures, documentation, instructions for frame agreement and its terms for instance. Laws also define practices for procurement control and remedies if laws are not followed. (Finlex 2021)

### 2.3.2 Purchasing agreements

Agreements are done after supplier selections between the supplier and the company. Commercial and legal terms and conditions are defined, for instance, based on products and purchasing policy in addition to terms defined in standard agreement. Fixed price and terms of delivery are results from competitive bidding. Price levels and service rates for spare parts are necessary to define in agreement for future needs. (van Weele 2010, p. 37-40) Van Weele (2010) highlights the importance of agreements and updating them in close co-operation with the internal stakeholders to ensure that the needs are defined. Thereby the best possible supplier is found for collaboration and continuous improvement implemented. (van Weele 2010, p. 218-219)

According to van Weele (2010), a payment method linked to supplier performance is preferred with a certain payment percentage of the total sum of delivery. Terms in the case of ownership transfers need to be defined into the agreement. Penalty clauses and warranty conditions are defined to ensure products are delivered requirements, quality and delivery performance. If supplier performance is not as agreed and it is causing costs to the company, cost charging from the supplier needs to be defined in the agreement. There are also defined general purchase conditions in agreements, for instance, insurance and safety regulations and contract transfer to third parties. The importance of the company´s terms of purchase is necessary to ensure that there is consensus when purchase orders are done and confirmed. (Van Weele 2010, p. 37-40) Services, expected service levels and responsibilities for parties are defined in Service Level Agreements (SLA). Financial and governance issues are defined in agreements and SLA is not defining those. SLA can be updated without updating the agreement. KPIs, penalties in case of agreements break and process for disagreements are all defined in SLA. (Emmett 2021, p. 63)

### 2.3.3 Business and sourcing strategy

As defined by Turnbull-Smith (2021) that the company´s strategy and business priorities are providing the base for systematic supplier development and thereby for functional supplier collaboration. According to Jain et al. (2021), sourcing strategies and management practices are affecting to SC´s ability to recover faster from disruptions. It has been stated that alternative supply sourcing can be ensured by supplier diversification in dual and multiple sourcing. On the other hand, supplier reliability can be improved by collaboration (Jain et al. 2021). According to Jain et al. (2021), recovery from disruption is slower in the case of supplier diversifications and faster in the case of long-term supplier relationships (Jain et al. 2021). On the other hand, importance of multiple sourcing and backup sourcing is defined by Mehrjerdi and Shafiee (2021) when considering disruptions or increased demand.

#### Category sourcing

According to van Weele (2010), a category sourcing plan needs to be in line with business strategy and goals. It is essential to identify the most important stakeholders to involve them in a cross-functional category team. In addition, the category sourcing plan needs to include analysis of historical data, for instance, current suppliers and their performance reports. Customer requirements and purchasing processes need to be defined, as well as objectives for sourcing; for instance, quality improvement needs to be defined. The commodity sourcing strategy need to be included with supplier performance requirements for instance. The activity plan needs to be included where communication and target setting are defined, for instance. Organization and information about the expected results need to be described. (van Weele 2010, p. 216-217)

### 2.3.4 Partnerships

According to van Weele (2010), partnership development with suppliers requires time. The relationship from operational supplier to tactical supply partner or strategic design partner requires 1-5 years of collaboration to develop. When the relationship develops over time to partner level, there is improvement in quality due to quality assessments by the supplier in processes or in design. Also, early supplier involvement in product design can be implemented. There is development seen in material flow, for instance, as the

electronic data flow. The contracts are developed as design contracts. In pricing, the open pricing is possible to be reached. (van Weele 2010, p. 221-222)

Trust and visibility are important elements to build strategic partnerships and collaboration (Turnbull-Smith 2021). In addition trust and visibility, continuity, knowledge sharing and transparency are needed (Ruuskanen 2021). Trust and visibility are enabled by accurate measurement data from EPR systems and regular review with suppliers´ measurement data. Supplier evaluation, segmentation and development are stated important to be done to strategic suppliers to promote continuous improvement. Supplier segmentation helps the company to identify suppliers who support their business needs and thereby identify needed development actions for each supplier. (Turnbull-Smith 2021)

According to Ruuskanen (2021) SRM enables better risk management and minimize the disruptions. When considering collaboration, the importance of careful supplier selection is stated by Ruuskanen (2021) to ensure that long-term goals, culture and development potential are in line with the company´s needs and goals. Interaction needs to be enlarged between supplier and buyer to collaborate through the whole organization. Active involvement of internal specialists from different levels to supplier meetings is stated to be necessary to commit business units to SRM and to ensure the availability of versatile competences.

Supplier early involvement is improving supplier performance (Turnbull-Smith 2021). Supplier early involvement is stated as essential in value creation with supplier development when suppliers´ development and innovation competence about processes or products can be utilized (Ruuskanen 2021). From an innovation perspective, suppliers are a necessary source, and therefore the involvement of suppliers is necessary to utilize their potential process and product innovations. Quality is increased and lead times shortened when suppliers are involved in new product development. Implementing supplier early involvement requires good internal cross-functional collaboration between production, product development and purchasing. (van Weele 2010, p. 229-231)

### 2.3.5 Supplier quality

According to van Weele (2010), quality is defined to be the level where customer requirements are fulfilled. When defining the quality level for the supplier, it is necessary

to define what are the quality requirements, how they are implemented, how fulfillment is monitored and what actions are taken if requirements are not fulfilled. (van Weele 2010, p. 238-239) In Finland, large buyers have formed a cluster, where they have created common criteria to assess HSEQ -capabilities and agreed of a common assessment method to validate suppliers. This cluster is moderated by a professional third party, Kiwa Inspecta. (von Weissenberg 2020) According to Kauppila, Jounila and Reiman (2020), the HSEQ® assessments and audits are adding value to companies by identifying and strengthening knowledge about their development potential and needs. HSEQ® assessments improve the SC competitiveness when quality defects and problems are minimized by careful root cause analysis and documentation. (HSEQ 2020)

Nowadays, outsourcing of non-core activities to suppliers is common and companies concentrate their resources on core activities. This means there are employees from different companies working in the company premises, which is called a shared workplace. A shared workplace is managed by the main authority, for instance, the host employer, who is responsible for the HSEQ management of all employees in their premises. There can be employees of various nationalities with permanent or non-permanent contracts which challenge HSEQ management. (Jounila et al. 2019) Regular audits keep up the continuous improvement from buyers´ and suppliers´ perspectives. It is also essential to use HSEQ® assessment results in supplier selection and procurement decisions which increase the supplier motivation towards audits. (Kauppila et al. 2020)

Tang et al. (2013) defines that supplier reliability can be improved by incentives that promote supplier process improvement and performance. Indirect incentives are connected to order quantity, and the investment is not made from the buyer side for suppliers´ process development. In direct incentive model, the buyer is participating in suppliers´ process development by investing, for instance, in technology investments. According to Tang et al. (2013), more reliable supply process can be enabled by the usage of direct incentives. (Tang & Gurnani 2013) According to Shokoohyar & Katok (2021), the supplier scorecard can be used to follow performance and thereby as a base for incentives. It is stated that incentives increase suppliers' interest to improve performance. (Shokoohyar & Katok 2021)

According to Jounila et al. (2019), supplier evaluation and auditing are the means for supplier development. Commitment from both sides - buyer and supplier- is necessary to

be able to reach results. It has been stated that the supplier´s performance can be improved and supplier-related risks minimized by supplier development activities. (Jounila et al. 2019) According to Kauppila et al. (2020), the HSEQ® assessment procedure adds value to SC since it supports the improvement of operational performance and supplier network sustainability. Nowadays many process industry worksites are multi-employer worksites due to outsourcing, and therefore the management of HSEQ issues is challenging. It has been seen that risks can be minimized by developing suppliers´ HSEQ capabilities. (Kauppila et al. 2020)

According to Jounila et al. (2019), buyers have experienced benefits from HSEQ® audits. The benefits for the business have been that the root causes for problems have been identified in the supply process, and quality-related cost have been saved. The audit system by external auditors has been seen as effective and high-qualified. When considering supplier development, the audits are essential in supplier performance development and target setting. It was also stated that performance in healthy and safety issues has improved. It was also stated that the HSEQ® assessments have improved the supplier performance and increased the learning from counterparts. HSEQ® assessments results can also be used for the supplier selection and common target setting to share the same targets and commitment. (Jounila et al. 2019) It has also been stated that the HSEQ® assessment procedure has an effect on the financial performance. According to Kauppila, Jounila and Reiman (2020), gross profit margin, which was used for financial performance indicator, is linked to higher scoring in HSEQ® assessment. It is stated that the companies with higher scores in the HSEQ® assessment allocate their resources more efficiently into the right tasks, which improve profitability and better gross profit margin. When considering the HSEQ procedure´ effects on the HSEQ® assessment scores, the positive development has been notified when investigating score trends from audited companies. (Kauppila et al. 2020)

The HSEQ® assessment can be started from need from a subscriber or from a supplier (HSEQ 2020). Most of the assessments are done to strategic suppliers which are considered strategic partner (Kauppila et al. 2020). The process starts from the supplier self-assessment, where the supplier evaluates their own status using the assessment question form. The next phase is assessment in supplier premises which is done in co-operation with company representatives from supplier, buyer company and third-party auditor. The audit consists of nine different parts, including 41 questions. The

performance level is evaluated based on the criteria on a four-point scale from 0 to 100%. If any correction needs or remarks are observed, the supplier needs to plan corrective actions. Supplier is responsible for following and developing the quality based on the findings in the assessment and final report. The development of continuous improvement is monitored in follow-up assessments. (HSEQ 2020; von Weissenberg 2020). PSK8404 standard is a supplier assessment tool only for self-assessment in the companies or to second parties. The standard is used to evaluate and follow up suppliers and their network quality performance to identify development needs in their operations. Results can be evaluated between companies and used for internal development in the company or to develop collaboration between companies. The assessment considers business management and production management, which in total include 14 parts. Based on the assessment results, the performance level can be calculated from the average of each operational area. (PSK Standards Association 2015)

## 2.4 Literature synthesis

Based on the findings in the literature review, answers to research questions (1) how can SCRes be defined in an energy industry context and (2) how to manage SCRes can be provided. SCRes is defined as the ability to tolerate and recover from crisis and to adapt after crisis, disruptions or changed circumstances. SCRes can be considered by engineering resilience as the ability to return to its normal balanced state after a crisis or ecological resilience, which considers several counterparts and their ability to develop, adapt and reorganize their actions to return to one of the several balanced states after the crisis. It is also considered as adaptive resilience as an ability to adapt to stress and change due to a crisis to a new normal state. SCRes is defined as anticipation, coping and adapting process, as well as responsiveness to the current situation, monitoring, identifying problems and learning from experiences. Organizational resilience is included as part of SCRes, which is defined as the ability to adapt and respond to changes by highlighting its abilities e.g. by cross-competence, interaction or innovativeness. SC finance can be stated as financial resilience since it reduces financial risks and promotes stability in SC. Financial resilience is a necessary part of SCRes. Adaptive cycle concepts define resilience as the ability to adapt and create new proactively in a known cycle. The adaptive cycle enables continuous transformation to build SCRes.

In the energy industry, SCRes is defined as an enlargement of safety. Ecological resilience in the energy industry is considered as the capability to prepare proactively to ensure fast recovery and adaptation if needed. It can be presented as a process of preservation, re-stabilization and transformation. When considering resilience as factual and value level, factual level defines objective, realistic figure about energy SC while value level defines values, beliefs and attitudes in subjective level. Learning ability, efficiency, redundancy and diversity are principles defining energy resilience. Resilience is also seen as a function to create diversity and connectivity. Engineering resilience considers resilience as robustness and redundancy, as well as capability to keep up performance in every situation. Resilience criteria include accessibility, affordability and acceptance.

SCRes depends on each counterpart in SC and therefore it needs to be managed through the whole SC at every business level by different capabilities. SCRes is a necessary tool in strategic management to increase competitiveness. Systematic, proactive and planning-based risk management in collaboration with the whole SC is base for SCRes building which is implemented by BCM and BCP. BCM is a proactive process to manage operational disruptions and BCP creates the base for the risk management in the company. BCM development is supported by NESA who is responsible for the security of supply in Finland. Company culture, change readiness in strategies and operational modes, visibility and collaboration with partners need to enable preparedness and survivor from a crisis. SCRes is promoted by flexible strategies e.g by multiple suppliers or partnerships. Flexibility and agility in decision making and actions are enabled by including SCRes as part of business strategy. SCRes management needs to be considered already in product planning and resource, strategic, supply and SRM due to their importance to SCRes. Financial resilience needs to be ensured by managing SC finance, building profitability and supplier finance follow-up. Creating organizational resilience in collaboration with companies is an essential part of SCRes management. SCres is measured using the KPIs depending on the company strategy to enable proactive risk management, effect mitigation and development strategy implementation which promote SCRes increase. SCRes critical capabilities development is enabled by systematic SRM which promotes collaboration and continuous improvement with suppliers and stakeholders. The critical capabilities for SCRes are introduced in Table 3.

Table 3. SCRes capabilities from the literature.

| SCRes capabilities | Description |
|---|---|
| **Collaboration** | Visible, solution-oriented collaboration, partnerships and trust through whole SC are base for the capability to stand against crisis and recover from those. Flexibility and collaboration are created by dynamics between organizations. Good information flow improves adaptability. Trust and visibility are increased by sharing the data from ERP systems with the stakeholders. |
| **Continuous improvement** | Continuous improvement is needed at every business level. Measuring, monitoring and analyzing KPIs are bases for continuous improvement. For instance, a supplier scorecard can be used for supplier performance follow-up. Continuous improvement and SCRes development are promoted by assessments implemented by the HSEQ® cluster. Assessments decrease risks by making them and development needs visible. Supplier assessments, supplier early involvement and good internal cross-functional collaboration promote development and innovations as well as commits all parties into development work. Supplier incentives promote supplier development. Suppliers´ quality include several elements e.g. delivery quality, accuracy and financial conditions, which are important to be considered in resilience building. |
| **Financial strength** | Common management of SCRes enables risk sharing and value creation. Management of SFC promotes innovations and collaboration. The whole chain needs to be considered to reach the optimal cash flow from a long-term perspective. By monitoring e.g. profitability and economic losses the finance can be strengthened. |
| **Long-term planning** | Systematic, long-term planning is a base to create resilience in the energy industry. SRM, continuity, finance, resource and competence management require long-term planning to reach the optimal and common targets. |
| **Organizational capabilities** | Organization ability and culture to identify, react and prevent risks are critical elements when creating resilience. Multiskilled employees with cross-competence, open conversational culture between organizational layers, involvement in strategic work and clearly defined instructions are important. Innovativeness promotes adaptability, agility, knowledge sharing and flexibility in the company and the creation of new capabilities, e.g in risk management. Innovations are the key issue in competitiveness, and flexible organization promotes innovativeness. Information sharing internally and externally enables improvements in SCRes. Agility is needed in the organization to be able to react fast in case of market changes and crises. Resilience is based on the adaptability in the company, e.g to change its strategy or operational modes if needed. |
| **Proactive risk and business continuity management** | Business Continuity Plan (BCP) is base for risk management which is created in collaboration with internal stakeholders from different organizational levels. The continuous, proactive process through whole SC enables risk identification, management and mitigation. BCP consists of defined business continuity needs, budgeting, risk analysis, business impact analysis, business continuity strategy, DRP, employee trainings, BCP testing and business continuity review. Business Continuity is promoted by the usage of SOPIVA-clauses provided by NESA in agreements and by collaboration in BCP creating with NESA. KPIs monitoring enables proactivity and SCRes development. Stress tolerance, a wide understanding of risks and the ability to learn and create new are important due to risks and vulnerability in the energy industry. Information sharing is promoted by national and company-specific risk and crisis committees. Safety inventories, backup plans and readiness to re-design SC are important. |
| **Resilience performance measurement** | KPIs are important to be used in proactive risk management to anticipate and mitigate disruptions. Supplier performance is necessary to be measured as it affects to company´s performance. Strategy objectives are |

| | |
|---|---|
| | followed up by KPIs. The used KPIs to measure resilience are varying depending on the company strategy. |
| **Resource and competence management** | Proactive resource planning ensures sufficient preparedness and optimal resource usage in a case of crisis. Resource planning is essential in continuity management and capability development. Employee commitment, involvement and combination of knowledge, competence and resources increase resilience. Cross-competence creates flexibility. Competence utilization from internal and external stakeholders promotes innovations. Competence development is promoted by collaboration through the whole SC when future competence needs are considered. |
| **Resilient strategic management** | Resilience needs to be part of business strategy to agile decision-making and actions. Business strategy is the basis for supplier development and collaboration. Resilience needs to be considered already in new product development as standardized products and various suppliers. There are several strategies to achieve resilience, and the strategy needs to be defined according to the company's priorities. Sourcing strategy affects to company´s ability to recover from disruptions. |
| **Requirements and specifications** | Correctly defined requirements and specifications by buyer company are base for purchase process and define supplier quality level. Internal collaboration is necessary to ensure correct specifications according to needs. Specifications are documented in agreements. In the energy industry, certain law requirements need to be followed regarding e.g. procurement, continuity management and safety. The currently ongoing change in the energy industry to increase renewable energy usage is changing the requirements. |
| **SRM** | Transparency, risk management, quality, trust and knowledge sharing increase through the SRM, which benefits all parties. Long-term goals, culture and development potential based on the same targets are necessary to be shared with suppliers. Interaction and continuous dialogue with feedback between suppliers and stakeholders promote collaboration and continuous improvement. Management models with regular meeting practices, common targets, common business practices and clear responsibilities promote successful collaboration. Strategic decisions in sourcing between decentralization of critical procurements and the importance of partnerships are necessary to considered from a risk perspective. |
| **Visibility** | Process visibility and routine creation increase organizational resilience. Visibility is important in partnership and collaboration building as it enables survivors from the crisis. Risk visibility is increased e.g. by information flow and assessments. Visibility and real time follow-up systems strengthen the SC in case of disruptions. |

# 3 EMPIRICAL STUDY

## 3.1 Research methods

The research is implemented as qualitative research where the data is collected from literature review and using semi-structured interview method to get qualitative data of critical capabilities in SCRes and how to improve SCRes in the energy industry. A semi-structured interview aims to get comprehensive information about the research topic (Polit & Beck 2010, according to Kallio et al. 2016) and it enables interaction between interviewer and interviewee (Galletta 2012, according to Kallio et al. 2016). It is a versatile and flexible method to collect data and suitable for individual and group interviews (DiCicco-Bloom & Crabtree 2006, according to Kallio et al. 2016). The research was planned according to a semi-structured interview guide framework (Figure 2) (Kallio et al. 2016).

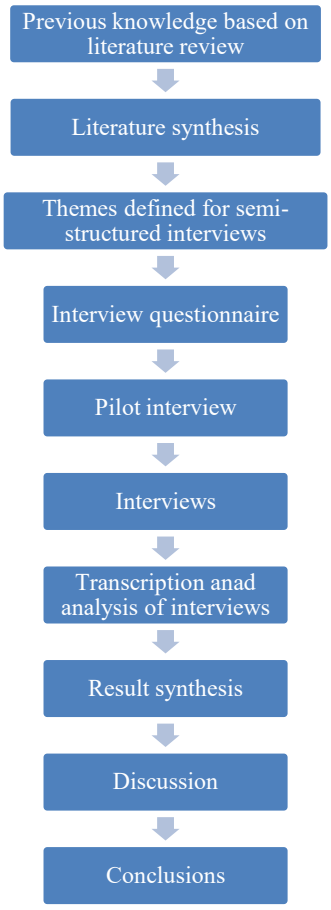


Figure 2. Research process using semi-structured interview (Adapted from Kallio et al. 2016).

Interview questionnaire (Appendices 1 and 2) was built based on the literature review, including the current HSEQ® assessment model and PSK8404 standard self-evaluation form. The questionnaire was divided into seven themes. In total, it included 48 questions divided between seven main themes of SC management, personnel management, continuity management, risk management, asset management, safety, supplier and stakeholder management as well as procurement. Separate follow-up questions were formulated for interviewer purposes. To complete the creation of the interview guide, a pilot interview was organized to test interview the questionnaire, and to get feedback on possible development needs.

Representatives from five companies from the energy industry and one from the process industry participated in the study. In addition, the National National Emergency Supply Agency was interviewed. Five of the companies were also HSEQ® cluster member companies. The HSEQ® cluster has been established by five industrial companies at the beginning of the 21st century to implement supplier assessments and to develop suppliers (Kauppila et al. 2020; von Weissenberg 2020). Nowadays there are 15 companies in the HSEQ® cluster which are from the energy, steel, technology and papers industry. These companies are committed to continuous improvement in HSEQ issues and fulfill the requirements in HSEQ® assessment at the needed level. Target is to improve business productivity, competence in HSEQ issues and quality of management. It also aims to support companies in systematic development and supplier selection. HSEQ® cluster is managed by a steering group which consists of members from cluster companies and a moderator, a third party inspection company (Kiwa Inspecta 2021; von Weissenberg 2020). The steering group is responsible for developing the HSEQ® assessment method, monitoring and organizing assessments. (HSEQ 2020) The pilot company was chosen from the energy industry. Participants were chosen from different positions and business units (Table 4). All participants received the questionnaire 1-2 weeks before the interview for reflection and preparation. All interviews were recorded with the permission of interviewees for analyzing purposes and the questionnaire form was filled with notes by the interviewer from each interview.

Interviews were conducted during February and April 2021. A total of 15 individual interviews and four group interviews were implemented as remote interviews using the Microsoft Teams application. The interview of the National Emergency Supply Agency was not included in the following calculations due to a different interview setup. The total

duration of all interviews was 1610 minutes, consisting of 1167 minutes of individual interviews and 443 minutes of group interviews. The duration of the shortest individual interview was 42 minutes and the longest 115 minutes. The average duration was 78 minutes in the individual interview and 110 minutes in the group interview. The duration of the shortest group interview was 64 minutes and the longest 175 minutes. A total of 2-4 participants took part in group interviews per interview. When considering the variation in interview durations, it needs to be notified that some of the interviewees answered only some themes and some participants to all. The duration was connected to the number of participants in interviews, and the increase of participants increased the duration of the interview. The planned duration for an individual interview was 90 minutes and for the group interview, 3 hours, which was approximately followed well.

Table 4. Interviewees.

| **Case company** | **Interview type** | **Position** | **Date** | **Field of industry** | **Interview duration** |
|---|---|---|---|---|---|
| Pilot company | Individual | Security, Risk and Quality Advisor | 8th February 2021 | Energy industry | 1h 14min |
| Company A | Individual | Production Manager | 11st February 2021 | Energy industry | 1h 24min |
| Company A | Individual | Senior Vice President, Operations and Asset Management | 11st February 2021 | Energy industry | 59min |
| Company A | Individual | VP Sourcing and Purchasing | 15th February 2021 | Energy industry | 1h 52min |
| Company A | Individual | Head of Unit Maintenence | 24th February 2021 | Energy industry | 1h 40min |
| Company A | Individual | Chief Security Officer | 25th February 2021 | Energy industry | 56min |
| Company B | Group 1 | Operations and Maintenance Manager | 16th February 2021 | Energy industry | 2h 55min |
| Company B | Group 1 | Operations Manager | 16th February 2021 | Energy industry | |
| Company B | Group 1 | Safety and Quality Manager | 16th February 2021 | Energy industry | |
| Company B | Group 1 | EHSQ | 16th February 2021 | Energy industry | |
| Company B | Group 2 | IT Security Manager | 22nd February 2021 | Energy industry | 1h 49min |
| Company B | Group 2 | EHSQ | 22nd February 2021 | Energy industry | |

| | | | | | |
|---|---|---|---|---|---|
| Company B | Group 3 | Sourcing Manager | 23rd February 2021 | Energy industry | 1h 4min |
| Company B | Group 3 | EHSQ | 23rd February 2021 | Energy industry | |
| Company B | Individual | Maintenance Manager | 18th March 2021 | Energy industry | 1h 40min |
| Company C | Group 4 | Environmental and Safety Specialist | 15th February 2021 | Energy industry | 1h 35min |
| Company C | Group 4 | Manager, Production and Asset Management | 15th February 2021 | Energy industry | |
| Company C | Group 4 | Operations Manager | 15th February 2021 | Energy industry | |
| Company C | Group 4 | Managing Director | 15th February 2021 | Energy industry | |
| Company D | Individual | Purchasing Manager | 17th February 2021 | Energy industry | 1h 39min |
| Company D | Individual | Operations Manager | 18th February 2021 | Energy industry | 1h 35min |
| Company D | Individual | Maintenance Manager | 18th February 2021 | Energy industry | 1h 24min |
| Company D | Individual | Safety and Security Manager | 22nd February 2021 | Energy industry | 58min |
| Company E | Individual | Supplier Development Manager | 10th February 2021 | Process industry | 1h 55min |
| Company E | Individual | Project Procurement Manager | 12th February 2021 | Process industry | 1h 29min |
| Company E | Individual | Project Procurement Manager | 23rd February 2021 | Process industry | 42min |
| National Emergency Security Agency | Individual | Power System Agent, Energy Supply Department | 23rd April 2021 | National Emergency Security Agency | 1h 4min |

Research data from interviews were analyzed based on interview notes and recording data. Recorded data were transcripted and combined with interview notes in Microsoft Word. All interview data were read through and collected into Microsoft Excel according to interviewees, companies, questions and answers. The total volume of answers was 732. Direct citations from interviews were added to answers and categories added to answers. According to Seidman (2006), categorizing helps to identify interesting findings and connections between answers to be able to find out the experiences from interviewees. Data was analyzed one question at the time and critical capabilities were identified

between different companies. Analysis of research results provided a versatile view of capabilities which are critical to SCRes and how to improve it in the energy industry.

# 4 RESULTS

Results from interviews are introduced in this chapter. The research data from interview notes and recordings were transcript, collected to Microsoft Excel and analyzed to identify and categorize findings. The main categories are based on the literature synthesis presented in chapter 2.4 and presented in alphabetical order in this chapter. The main categories are continuous improvement, continuous performance measurement and follow-up, internal and external collaboration, long-term planning, proactive risk and business continuity management, resource and competence management, requirements and specifications, systematic SRM and visibility. The research questions (3) what capabilities are critical to be considered to ensure high SCRes in the energy industry in Finland and (4) how to improve SCRes in the energy industry in Finland are partially answered at the end of this chapter.

## 4.1 Continuous improvement

Continuous improvement as part of the work was seen as necessary in most of the companies. It was mentioned by one company that the internal or external personnel´s opinions are not heard enough. Root cause analysis and development actions based on that were seen as necessary by several companies. It was seen important as it decreases risks for example in case of continuous failures in production which can be caused by improper maintenance or usage.

Occupational safety was seen also seen as a necessary element by most of the companies to be improved continuously. Thereby documentation of incidents and accidents was seen necessary, including root cause analysis and corrective actions to be able to improve safety. Risk identification and action plans, instructions, management and monitoring were highlighted. It was also highlighted that everyone in the company is responsible for safety monitoring and risk identification. Observation rounds were mentioned as essential by most of the companies to identify development needs. Safety observations were indicated important to be done proactively for both suppliers and buyer company. It was highlighted that monitoring is necessary to measure and follow the progress.

In cyber security, it was emphasized by one company that digital identity is important to manage to ensure better visibility in the process and to build automated processes.

Continuous improvement was mentioned as essential in safety development by most of the companies. It was considered important that safety needs to be monitored, documented, instructed and trained continuously for all internal and external employees, as for instance interviewee 2 pointed out:

> *We are developing and maintaining our safety by management. (Interviewee 2)*

In safety issues it was emphasized that more systematicity is needed as standardized instructions, increasing proactivity and preventing incidents as well as identification of risks and mitigations activities can increase resilience. The actions and the effect of evaluation of the actions were emphasized important as well. Continuous improvement with root cause analysis was highlighted by several companies.

Joint workshops with members from different stakeholders were seen useful according to most of the companies. One company considered important that there had been established development teams, for instance, for crisis management and safety in national and organizational levels where employees from different organizational levels are involved. It was also highlighted by most of the companies that employees need to be involved in safety, risk management and continuity management planning and development to ensure that the solutions are working at operational level.

According to several companies the sourcing development is done in co-operation with the sourcing team and operations. It is pointed out by one company that employees in the sourcing team are involved in development by giving responsibility to implement development based on a common sourcing strategy and management model. In one company, employees have the responsibility to lead development projects in their own responsibility area. It was seen as important to involve sourcing team members to different groups organized by Finnish Association of Purchasing and Logistics (LOGY) to get new development ideas and for networking.

It was emphasized that agreements are needed with some suppliers to be able to clarify the safety requirements and need more comprehensively. An increase of auditing was seen as necessary by several buyer companies to develop the safety, for instance, in suppliers´ value chain. According to most of the companies, data from HSEQ® assessments is essential to improve safety. Interviewees pointed out that by sharing best

practices between business units, safety could be improved. The importance to increase proactive observations was seen as necessary when increasing resilience, as for instance interviewee 9 pointed out:

> *Increasing proactive observation is concerning the whole SC internal as well as external employees who are doing operational work in the field. (Interviewee 9)*

It was considered as essential to give feedback to suppliers about safety issues as well. It was mentioned that the suppliers need to keep their qualifications up to date. Risk evaluation before starting a work is part of the safety requirements. In safety follow-up the audits were mentioned to be used.

### 4.1.1 Personnel involvement

Personnel involvement was seen as important by most of the companies and there is still more development potential to implement involvement into practice. There are different kind of systems in use in several companies where employees can report defects or development proposals. Development proposals are processed in development teams. In some companies, there is rewarding practice in use. Internal dialog and open discussion were mentioned by most of the companies to be essential when identifying development needs and brainstorming of those. It was indicated by all companies that eagerness and motivation for development and innovations were varying between companies and employees. Employees are participating in development in most of the companies, and employees are encouraged to the development and innovations, as for instance interviewee 25 pointed out:

> *The employees´ eagerness for development is a lifeline. (Interviewee 25)*

Personnel was involved in strategy work in most of the companies in different ways. In most of the companies, the decisions and strategic alignments were made in the management. The decisions about daily operations were indicated to be done at the operational level. The employees were participated in strategy work by using employee surveys, arranging development days or via initiative committee to develop and innovate proposals for strategy deployment, as for instance interviewee 14 pointed out:

> *In our company we have open and visible strategy implementation and action plan building where everyone had an opportunity to produce contents. (Interviewee 14)*

It was emphasized by one company that the involvement of employees has improved which has increased common discussions and thereby employees´ commitment. According to one company they involve employees and service providers closely in strategy work. It was highlighted by most of the companies that there are always differences between employees on how actively they participate in development and how innovative they are. Still, the employee involvement was seen necessary as they are specialists in their own field, as for instance interviewee 7 pointed out:

> *Employee involvement is very important already from the power plant design phase. (Interviewee 7)*

According to one company, it is essential to involve suppliers in development as early as possible as for instance interviewee 4 pointed out. Common development workshops with suppliers were found useful for development, and those enable common brainstorming and new ideas between the buyer company and supplier. On the other hand, there was a challenge in early involvement in tendering or offer request situations because of the law, as for instance interviewee 4 pointed out:

> *Management of external resources could boost improvements better, and risks would appear better. (Interviewee 4)*

> *Public tendering is hitting ears for early involvement. Of course, they (suppliers) can be asked to familiarize with topics, but nobody can be favored even if they would have done brainstorming in the bidding phase. It is blurring the collaboration. (Interviewee 4)*

## 4.2 Continuous performance measurement and follow-up

When considering the measurement of SCRes, companies mentioned several ways to measure performance. There were no formal KPIs for SCRes mentioned. There was a large variation between the companies´ ability to measure and follow SC performance.

According to one company they are taking use of the Best-In-Class tool provided by LOGY to evaluate their own maturity. Supplier and service provider performance measurement was considered to be a development topic in several companies while a new category sourcing model was taken into use. It was also pointed out by most of the companies that in addition to measuring, it is important to follow and implement corrective actions when the measures indicate the need. It was mentioned by most of the companies that it is important to follow suppliers´ situation continuously. According to several companies, the data is needed to be able to manage, as for instance interviewee 6 pointed out:

> *Without data you can´t manage, but on the other hand information needs to be always certified so trust is nice, but control is better. (Interviewee 6)*

Most of the companies emphasized that they measure the liability of the power plant. The liability of the power plant and additional costs of production were emphasized as essential by most of the companies which correlate with the failures in production. They cover risk management, business continuity and asset management as well. From a business continuity perspective, liability was indicated as an essential measure by most of the companies. It was emphasized by one company that liability is one of the key measures for service providers, as for instance interviewee 17 pointed out:

> *Liability is one of the KPIs for service providers. (Interviewee 17)*

Several companies emphasized that they measure additional costs of energy procurement. From the cost perspective, it was emphasized as important to follow up insurance and damage costs. Sourcing cost savings were indicated by most of the companies to be measured. Interviewees pointed out that maintenance, revision and investment costs are used as indicators in asset management. Also, costs caused by disruptions were indicated to be used.

Device failure rates were mentioned to be used as indicators in asset management. Fault interval was pointed out to be used as a measure in one company. From a business continuity perspective quantity of all disruptions and their duration and recovery times were indicated as necessary measures by most of the companies. Quality defects, quantity and root cause of them were indicated to be followed in several companies. From a continuity development perspective, the implementation rate of development plans was

mentioned as well. Those were also mentioned to be followed to measure supplier quality. Those can indicate a need for maintenance, investment or development needs in suppliers or service providers operations.

From a business continuity perspective, the quantity of defects and implementation rate of corrective actions were indicated as necessary measures by several companies. Most of the companies are measuring KPIs in production like the number of leakages, the number of failures and duration of the failure. One company is evaluating supplier performance by review of successes and failures at the end of the year. Regarding critical suppliers SCRes is monitored by following a number of reclamations. From business continuity perspective, the number of reclamations and the implementation rate of corrective actions were indicated as important measures by several companies.

In safety measuring the number of accidents was seen as essential by all companies. Accidents are monitored separately for the own company and for the supplier, and root cause analysis are done together with suppliers in case of accidents. Safety observations and progress of corrective actions as well as incidents are monitored by several companies. In one company the safety observations are monitored according to each supplier. Safety is monitored from the suppliers´ side by continuous probity follow-up implemented by authorities. Qualifications for personnel were emphasized to be defined in agreements, and from the personnel, it can be found out who is working in buyer company premises.

Several companies pointed out that the supplier´s economic situation is critical to be followed. Some companies have outsourced supplier´s economics follow-up for an external company that is continuously monitoring financial defaults even twice a day. On the contrary, some companies found economic monitoring necessary in case of some problems were indicated. According to several companies, they are following suppliers´ economic situation and solvency, for instance. Regarding critical suppliers, SCRes is monitored by following the development of turnover and profit. It was emphasized by most of the companies that they measure payment term fulfillment of suppliers. Also, the share of the procurement compared to the supplier’s turnover was mentioned.

It was emphasized by one company that they are developing indicators to measure supplier performance. That would include indicators for price trend, failure interval and service response time, as well as evaluation about quality of documentation and inquiry

about supplier´s capability to serve sourcing team. Supplier´s response time is measured if the response times defined in SLA can be fulfilled. One of the companies indicated several different measures for supplier performance, like the number of reclamations and defects, SLA conformity, costs, quantity or disruptions and failures. Satisfaction surveys and measuring is used internally in the organization to measure if the supplier has been satisfied with.

In several companies, HSEQ criteria were pointed out to be used as a measurement for service providers. Another company is using HSEQ® assessment results from the audit as a measure of suppliers´ reliability. It was also pointed out by several companies that the availability of continuity plans, contingency plans and risk plans, as well as quantity of practicing, can be used as an indicator describing preparedness level, and those can be followed. Also, the quantity of risk analysis in organizations gives a perspective for preparedness.

The success of maintenance was stated to be followed by comparing the planned budget, disruption times and durations to realized measures. According to one company, they have bonuses and sanctions defined for some service providers. On-Time-Delivery (OTD) and delivery accuracy are used in most of the companies to measure suppliers´ ability to deliver the right products at the right time. According to several companies, the OTD -rate and its trend, as well as the delivery times were considered to be used to measure supplier performance. The availability of spare parts was indicated as one essential measure.

## 4.3 Internal and external collaboration

All companies have numerous suppliers, service providers, authorities, and other partners who to cooperate with, for instance in fuel deliveries, maintenance service and spare part deliveries. It was also pointed out that the internal collaboration and partners are important. Internal collaboration and involvement between different stakeholders were seen as essential to be able to define internal needs better. Another company raised up the importance of internal collaboration to increase the understanding of what is critical to be done and why. The dynamic culture was mentioned to be important by several companies when the culture is created from the management to operational level, and it promotes the dynamic atmosphere.

Collaboration and dialog between internal and external stakeholders are seen as one of the necessary actions preventing SC disruptions and build resilience in SC. According to most of the companies there is still a lot of development potential to increase SCRes with collaboration even if the network collaboration has increased from the past. It was considered crucial by one company that the interaction between different stakeholders has increased from bilateral discussions to network interaction where everybody´s knowledge is taken into use, as for instance interviewee 25 pointed out:

> *It is not anymore that the buyer (company) is giving the development proposals but also the supplier is actively giving development suggestions to do otherwise. (Interviewee 25)*

Continuous collaboration was seen as necessary to promote continuous improvement and development by most of the companies. It was highlighted by one company that they are planning to have a development project together with their service provider network. Interviewees pointed out that active collaboration is important internally and externally with suppliers, generally in energy field and with National Emergency Supply Agency e.g. in The Power and District Heating pool groups. Collaboration is seen essential when considering the common trainings.

It was emphasized by the energy supply agent in NESA that network collaboration is essential in several perspectives. Collaboration is needed between different companies in the energy sector but also through the whole SC to increase the discussion on how to improve resilience and preparedness. The Power and District Heating pool organized by NESA provides a good collaboration channel to implement the network collaboration and develop the preparedness. The importance of collaboration in the case of outsourced services was highlighted. There are service activities outsourced to external service supplier companies which provide their service to several energy companies. In case of major disruptions there need to be proactive planning and training done in cooperation with the energy companies and service provider. It also needs to be defined beforehand how the service resources are used and allocated between different energy companies to ensure optimal resource availability. To ensure preparedness it is important to implement the collaboration through the whole network.

## 4.4 Long-term planning

The long-term planning, anticipation and implementation of plans were highlighted by all companies when considering all actions in business/risk management, safety, maintenance, investments, lifecycles and asset management, for instance. According to several companies it is important to implement long-term planning for the future in own organization and on suppliers´ side but also mutual planning with supplier and the buyer company. The common targets and awareness about risks were seen as essential by most of the companies. According to several companies, it is important to follow the implementation of the plans for prioritized issues to ensure that the development and actions are proceeding as planned. Data availability from systems was seen as necessary for long-term planning in investments, revisions and maintenance.

Interviewees pointed out that long-term planning in the energy field means exceptional long time compared to other industry fields, which was seen as a challenge. Systematic long-term planning was pointed out to be extremely important by several companies since the viewpoint is reached for 5-25 years ahead. In long-term planning, it was emphasized important to consider risks as part of asset management. When considering the schedules for revisions, the global markets and fuel price variations affect the decisions. According to several companies, long-term planning and its implementation under control and plans are essential from an asset management perspective to ensure long and optimal lifecycles.

Interviewees pointed out that the lifecycle management of production assets needs to be continuous to ensure that the production devices are capable of future changes. It was also emphasized as essential to consider what kind of devices are needed in the production, create the maintenance plan and ensure that the needed maintenance competence is available from internal or external resources with reasonable costs in Finland. High-quality preventive maintenance is a critical factor from all companies' perspectives to prevent production disruptions and to get information about the situation before the failure occurs.

It was also mentioned that long-term investment and maintenance plans need to be in place and lifecycle management proactively planned and organized. The importance of lifecycle management was highlighted regarding IT systems and devices, as well as the long-term maintenance availability for what was seen necessary by several companies. It

was emphasized that the high-quality maintenance extends the lifecycles. It was emphasized that safety need to be taken into consideration in the long-term planning when building a new power plant for instance. The safety risks were pointed out as necessary to evaluate from the whole SC perspective. According to one company the planning and proactivity are needed to ensure safety operations.

## 4.5 Proactive risk and business continuity management

A business continuity plan was mentioned as essential by all companies, and it was created in all companies at some level. It was emphasized that the name of the plan is varying in the companies, and it can be, for instance, risk, continuity or recovery plan. Proactivity was highlighted by several companies as the most significant element to decrease risks and increase resilience which requires improvement in buyer companies and suppliers, as for instance interviewees 3 and 25 pointed out:

> *Promoting proactive thinking is the most important issue to be done. (Interviewee 3)*

> *Proactivity needs to be sharpened to be able to consider risks wide enough and far ahead. (Interviewee 25)*

It was mentioned that it is necessary that requirements and threats are identified as well as the critical products, services and suppliers. It was mentioned that risk analysis needs to be done to include the risk management action plan and recovery plan to cover the whole SC. The recovery plans were indicated to be required by the law. Interviewees pointed out that there needs to be an organization model available for exceptional situations.

### 4.5.1 Risk management

According to several companies, there are a lot of risks related to SC. The service provider and its work quality is identified as one risk by several companies. The quality, delivery accuracy and contractual risks are mentioned as the main risks in supplier. Also, availability of raw material, availability of workforce, predictability of costs, maintenance availability and suppliers' financial conditions were seen as critical. It was emphasized

by most of the companies that it is necessary to pay attention to cyber security risks and ability to identify those.

Most of the companies pointed out that in addition to understanding the supplier-related risks, it is also necessary to understand the risks from the beginning in the supplier´s value chain, for instance, related to raw materials or components availability, as for instance interviewee 25 pointed out:

> *When considering the SC risks we too often consider only the first-tier supplier with who we are signing the SLA without considering their SC and related risks where the highest risk can be one single component. (Interviewee 25)*

Suppliers´ plan review for risk identification and mitigation was seen necessary to get the visibility to risks. The common risk mapping, site visits, observation rounds and planning together is seen essential to be done regularly and continuously, which is monitored by the buyer company. Continuous collaboration and risk scenario practicing were highlighted as essential in common risk management by several companies. It was emphasized that the current risk preparedness level in the supplier´s value chain is inadequate since there are risk analyses missing and risks are not well understood.

According to one company it was essential to increase awareness about the realized risks related to suppliers, for instance in quality issues to increase the visibility about risks. The management of deviations by new systems and process clarifications is seen as important to increase visibility. The importance of insurances on the supplier side was mentioned. It was considered crucial to follow suppliers ´ conditions continuously by assessments. Proactive and continuous follow-up was highlighted by most of the companies, as for instance interviewee 20 pointed out:

> *You need to know your suppliers´ situation. It requires systematicity to be able to anticipate what is going to happen in the future. That is the most necessary thing. (Interviewee 20)*

It was mentioned by several companies that there are major risks related to the supplier network. Those were emphasized to be mitigated by considering risks widely, proactive preparations and continuous follow-up. It was emphasized that risks are often in practice

outsourced to suppliers´ responsibility by trusting on insurances. The risk mapping and evaluation of effects need to be done continuously. In several companies, the risk management was seen as important to be done in co-operation with the suppliers based on the criticality classification.

Relying on a single supplier and poor agreements as well as resource, quality, finance and delivery accuracy risks were considered as identified risks in supplier interface by several suppliers. Also, material availability and proactive planning are indicated as well. It was highlighted that risk management needs to be considered in procurement, as for instance interviewee 20 pointed out:

> *Delivery capability and risk related to it are the basic issues that need to be considered in procurement. It is critical to be aware of the capability before any purchases. Risk identifications is very important in that phase. (Interviewee 20)*

It was emphasized by most of the companies that risk management and identification are important to be a part of category management. The supplier evaluations and development discussions after projects with active supplier management methods are considered important as well. The longer contractual periods are seen as important to ensure the availability of resources and needed service level.

According to most of the companies the competence risk is decentralized by using several service providers. The agreements with the service providers were seen necessary as risk management since several activities are outsourced. In supplier management, the financial, quality and delivery accuracy related risks are pointed out to be minimized by terms in agreements, as for instance interviewee 25 pointed out:

> *Terms and conditions are the everyday risk management tool. (Interviewee 25)*

> *When the purchase is made, we can´t trust that the product is delivered to us after a long time. The follow-up and monitoring during delivery plays a big role in progress monitoring, quality control and supplier situation monitoring. (Interviewee 25)*

It was indicated by most of the companies that there is a need to improve risk preparedness on the supplier side. It was seen as important by several companies to update the risk evaluations related to service providers to develop and ensure the high preparation level continuity management.

### 4.5.2 Business continuity

The importance of preparedness and proactive planning was highlighted by the energy supply department in NESA. Interviewees pointed out that there is variation in the current level of preparedness planning and in the quality of the plans in the energy companies and in their suppliers. Supplier weak preparedness is emphasized as a risk for the whole SC, and the preparedness plans need to be required from suppliers. When the buyer company is well-prepared, it is necessary that suppliers implement the same practices as the buyer company, as for instance interviewee from NESA pointed out:

> *If the company is smart and cares about its business and its customers, they create the preparedness plan. (Power system agent, Energy supply department, NESA)*

The proactive risk preparedness and planning in buyer company was pointed out as a critical issue by most of the companies. It requires that the risk management plan is created where the risks and threats are identified, evaluated and analyzed and probabilities defined. It was considered important by several companies that the risk analysis needs to be updated regularly, it needs to cover the whole organization and actions with follow-up planned based on that. There needs to be a plan for risk mitigation or elimination which is followed up project-specifically. Crisis management and crisis communication were seen necessary as well. Several interviewees also highlighted the importance of training, simulations and practice, as for instance interviewee 1 pointed out:

> *In risk analysis, the most important thing is to identify the possible occurring serious threat and crisis situations and plan how to prepare for those by planning, instructing, training and practicing. (Interviewee 1)*

According to all companies, there are several risks that can be caused by the buyer company´s own actions. It was mentioned by one company that if the risks are realized, it is necessary that the manager can manage the situation logically. It was seen as

important by most of the companies that risks are visible for the management and part of the decision-making in executive teams. It was emphasized that the risks are reviewed internally in executive teams as well as in the energy market management team to get extensive understanding of the possible risks.

It was pointed out by one company that the risk management policy and continuity need to be combined in the risk management plans. According to most of the companies there was development potential identified. It was emphasized by several companies that the risk management plans, and development plans are missing, or they are inadequate. Also, the practical trainings in case of crisis and the management of them need to more regular. There is also variation in the quality of plans. The clear instructions are pointed out as supportive in case of crisis, as for instance interviewee 1 pointed out:

> *There are exact instructions in the company which are used immediately in case of crisis. All the potential disruptions are checked through and checklists are created for the serious disruptions which can develop quickly. (Interviewee 1)*

In one company, risks, risk levels, priorities and action plans are defined in a shared system, which was seen as important. It was highlighted by most of the companies that there need to be proper tools for risk management and analysis available. If the risk realizes, the preventive actions for the future are defined. It was seen as important to have discussions about the occurred risks and consequences as well as analyze the root causes.

It was emphasized by one company that there is weakness in project management, strategy deployment and change management. There was also indicated that the law requirements need to be better followed, more proactive preparations for serious threats needed, and the quality of agreements need to be improved. It was also pointed out that the root cause analysis needs to be improved. Cyber risks are seen as high risks in the energy industry, especially regarding ERP- systems, as highlighted by one company. Therefore, it is pointed out that the telecommunication network is necessary to be monitored 24/7 by external service provider.

In risk preparedness actions were mentioned by several companies when the responsibilities and responsible employees defined and trained and instructions prepared. The management group and communication plan were seen as essential to be done

beforehand. Trainings were mentioned by several companies, and one company mentioned that there is development ongoing for the virtual training environment. It was also mentioned that the emergency simulations are essential. Interviewees pointed out that it is important to do the risk evaluation systematically for the bigger purchases when the quality and delivery accuracy risks are considered. The documentation was mentioned as essential as well.

In most of the companies, risks are managed and mapped through the whole company by the risk management unit. Businesses in maintenance and operations units also have the responsibility for risk mapping in several companies. Availability of risk management specialists was pointed out as an essential resource in companies due to the need to provide support for risk analysis preparations. According to one company, risk management was seen as inadequate since it is done only once a year. It was considered crucial that risk management needs to be more regular and part of the decision making, as for instance interviewee 25 pointed out:

> *Risks and risk management are considered process by process. (Interviewee 25)*

According to most of the companies, it is important to have Business Continuity Plan from suppliers as well. They have found it necessary to define instructions and a checklist about the requirements in BCP. Interviewees pointed out that there is development potential in BCP preparedness. It is emphasized by several companies that auditing brings out and locates risk elements which increase the visibility to chain and risks. The Disaster Recovery Plan reviews need to be included in audits as well. It was mentioned by most of the companies that it is important to require continuity plans from critical suppliers. Several companies highlighted that the suppliers need to implement their own risk mapping and contingency plans, and the buyer company needs to take care its own plans.

It was emphasized by most of the companies that it is important to continuously improve operations, simplify the instructions and implement trainings to improve risk management. Understanding the risk effectiveness was seen as important related to finance, liability, and safety for instance by several companies. According to several companies, it is necessary to have global SRM tool which is accessible by the supplier as well. Through the SRM system, suppliers can do self-assessments and supplier assessments are visible in the same systems, which provides global visibility to the

supplier network to everyone in the organization. According to one company, the security check is critical when considering both the suppliers and buyer company employees.

It was emphasized by most of the companies that the competence personification in their own organization or suppliers' side is a challenge. When considering the suppliers, it was highlighted that there need to be optional suppliers available and evaluation done for temporal and monetary risks if the optional suppliers need to be used. It was emphasized that critical suppliers and their ability to operate are essential to be ensured by 24/7 follow-up for company finance. The continuity for critical operations is important to be ensured by also using emergence inventories. Continuity plans are indicated necessary to be required and prepared in cooperation with the suppliers how the operations are decentralized, and continuity ensured.

It was also pointed out by most of the companies that it is necessary to have reliable partners and power plants need to be up to date to ensure continuity. Insurances were mentioned as essential in business continuity by several companies though it was highlighted that the insurances are not the solution to recover from disruption itself.

According to one company, it is essential to define the business impacts how the disruptions are affecting business. There needs to be the ability to prioritize own products and services, which are critical to maintain, and which can be limited in case the production needs to be limited during disruption. It was emphasized that the recovery plan needs to include the identification of serious and rapidly occurring risks.

### 4.5.3 Collaboration

It was considered crucial by most of the companies that the development of collaboration with suppliers reduces the risks when the needs are better known and thereby better served. The criteria definition for the approved suppliers and yearly supplier assessments were mentioned to be important. It was emphasized by several companies that common and active and continuous brainstorming with suppliers is very important when managing the risks. It is vital to create plan with supplier, as for instance interviewee 5 pointed out:

> *We must continuously consider in cooperation with the supplier how to tackle away pandemic and manage it to ensure that we have healthy staff available from them and how the service provider is prepared that we have*

> *resources available to secure the production even if the pandemic expands. We are having open discussion, and the plan is written down on how to prepare for the risks, for instance, pandemic. (Interviewee 5)*

To promote development in risk preparedness, there are different organized pools by NESA which are developing tools for the companies for preparedness. Pools have a significant role in the development of preparedness as there are several energy companies participating, but suppliers are in a smaller role. In Power and District Heating Pool, they have created e.g templates for preparedness plans and checklists for what needs to be considered. Checklists are seen as useful to be created for all suppliers. Collecting contact lists and operating models are mentioned as important and easy ways to start creating a preparedness plan. In preparedness, the commitment of management was pointed out necessary to implement preparedness in the company. It was highlighted that the tools created by pools should be more utilized in the companies and suppliers to get more information about the importance of preparedness and its benefits for business and customers.

### 4.5.4 Long-term planning

According to most of the companies, risks are decreased by proactive long-term planning of preventive maintenance, risk mapping, spare parts management, resource planning and common trainings with the supplier as well as with the authorities. Management and communication models are seen as important to be prepared beforehand, as well as the operating instructions for the emergency situations. Risk management was pointed out to be continuous evaluation, and it was seen necessary to consider the whole energy SC to ensure proactive preparations, as for instance interviewee 5 pointed out:

> *In damage situations the recovery times are short and therefore we need to pay attention to damages and manage the whole SC including own employee, service providers or suppliers. (Interviewee 5)*

Long-term planning has a necessary role when ensuring continuity by several companies. It was also pointed out that the risks need to be identified and evaluated continuously and implement continuous improvement. It was emphasized important to follow the implementation of development projects and safety perceptions to ensure proactivity and to decrease the liability risk.

## 4.6 Resource and competence management

Resources are considered as important by several companies. Human resources availability, enough competent employees and the importance of deputy personnel were highlighted by all companies. It was emphasized by most of the companies that it is important to identify critical work tasks from a business continuity perspective as well.

Several companies highlighted that the exemption from military service need to be done for critical operations employees both in buyer company and suppliers. Most of the companies highlighted the importance of deputy persons for every employee but some companies have only emergency employees. It was also pointed out that the usage of temporary staff is necessary for most of the companies to balance the workload.

It was mentioned that there has been problems getting foreign labor during the Covid-19 pandemic, and it needs to be ensured that there are competent resources available in Finland in all situations. The proactive resource planning and reservations were highlighted in special work to be able to get the needed resources. The competition from employees between other employers was seen as a challenge, especially during the Covid-19 pandemic. Labor availability and committing employees were pointed out as critical by several companies, which can be promoted by taking care of well-being at work.

Proactive planning with supplier network in cases of work overload was emphasized necessary by one company to ensure the agreed lead time in every situation. It was also pointed out that overload situations are prepared by organizing flexible capacity from suppliers and industry services. It was mentioned that suppliers and service providers need to make sure that they have competent employees for deputy purposes internally and in their value chain.

Interviewees pointed out that careful orientation for new a employee takes about a year which requires proactivity in competence and resource management. Senior experienced employees have an important role when training new employees and transferring their knowledge to new ones. Comprehensive orientation for new employees was raised up by most of the companies. In addition, the trainings, education and rehearsals were seen as necessary by several companies. There was also seen a need to update competencies to fulfill the requirements in today´s business life. The mentor-coaching model was seen as a good way for that, as for instance interviewee 4 pointed out:

> *New thinking and operational models will be successfully implemented using mentor-coaching model. (Interviewee 4)*

The training plan and register are pointed out as important by all companies to be able to plan and follow the qualifications and development. Some of the trainings are statutory. The career paths are provided to ensure employees development in and commitment to the company. The development discussions are kept once a year or even more often where development needs and plans are done. The minimum qualification requirements are defined in most of the companies for each position and those are reviewed and updated regularly.

Education and training programs were mentioned as important by most of the companies. It was emphasized that there need to be learning paths available to ensure career development. It was also mentioned that there are qualification requirements for the supplier network to be able to enter to the power plant area. The supplier plans for competence development are essential in one company. Those are defined in the SLAs to get supplier committed, as for instance interviewee 6 pointed out:

> *When we are making the SLA with the supplier, we require a description of how they take care of their employees and maintain their trainings, as well as how they see the company is going to develop in the upcoming years. (Interviewee 6)*

### 4.6.1 Critical competences

According to several companies, it is critical to identify critical competences and capabilities. It is also important to understand the current competence state and what kind of competence needs to be increased internally in the organization and keeping the competence up to date as well as by recruiting new employees. According to most of the companies the identification of critical competencies and tasks is essential to be able to define tasks that can not be outsourced.

Interviewees pointed out that the critical key competences need to be identified and defined more carefully to be able to define the deputies. Currently, the unclear definition of key employees is causing a high risk as well. It was emphasized by most of the companies that the competence or knowledge should not personalize only to one person.

In the critical competencies, manager´s ability was highlighted to lead and manage even in a crisis situation but also in daily operations. Project management and IT skills were seen critical as well. The understanding of special situations and the cause-effect relations behind them were seen as essential by one company. Technical competence was mentioned as necessary by all companies. It includes the plant operations including automation and electric competence and process competence. Fuel logistics was identified necessary competence as well. In procurement, for instance energy supply, category-specific competencies including new solution businesses and global direct sourcing were mentioned as one of the key competencies. In supplier collaboration, both operations and procurement are important to participate to enable technology and procurement perspectives into use.

### 4.6.2 Cross-competence

Cross-competence was seen as an important way by several companies to develop employees´ competence and thereby increase resilience in SC. It is implemented, for instance, by changing tasks in job rotation and encouraging employees to transfer to new tasks. According to one company, the matrix organization supports the operations where everyone knows the duties of others proactively. The deputy personnel´s ability to make decisions was pointed out important in promoting flexibility, as for instance interviewee 21 pointed out:

> *Cross-competence has been nurtured and maintained, and employees want to develop their skills. (Interviewee 21)*

It was emphasized by several companies that there is cross-competence available between employees working in the same units e.g., in plant operations and procurement but not between different product areas due to wide variation. The competence map from employees´ competencies has been used in one company to identify the available competencies per employee and to define who can work crosswise. Most of the companies mentioned that it is typical in power plant operations that absences are not stopping the plants. According to most of the companies, there is a lot to develop in cross-competence because some employees are refusing to share information, and it prevents cross-competence from developing in the organization and networks.

### 4.6.3 Social capital

According to several companies, social capital can be increased by close co-operation with supplier network and networking was seen necessary when building competence. It was considered as essential to arrange common development meetings with the suppliers to discuss what kind of competence is needed. The competence is also increased by doing maintenance together with service providers in most of the companies. The common workshops with suppliers and early involvement are increasing the social capital for both parties, as for instance interviewee 14 pointed out:

> *We are organizing common development days semi-annually with the most important partners where we go through the development issues and targets. In addition, we have collaboration groups with other companies operating in the same field where the competence and information are shared. (Interviewee 14)*

Responsibility needs to be shared with different employees, which was pointed out by most of the companies. Several companies brought up the importance of competent employees and directing them internally into the right positions to increase SCRes. Competence maintenance and continuity were mentioned as essential by most of the companies. In several companies the maintenance or operations teams are emphasized to act as the first contact to supplier or service provider where the technical knowledge is necessary. In most of the companies, the procurement role is to provide support to maintenance and operational teams in contractual issues etc. Several companies pointed out that the SRM needs to be developed by increasing the procurement competence of employees responsible for the supplier interface.

The personnel and resource planning for the future needs was highlighted by most of the companies to be able to define the competence needs for correct areas. When the future competence needs are identified and prepared, it strengthens the organizational resilience. The ongoing changes in the energy production towards renewable energy are pointed out to have an effect on the competences which are needed and which competences need to be retrained. The availability of competent employees was seen as essential. Because of that the competence requirements were seen as important to be defined and communicated to own employees but also suppliers and service providers to ensure the

competence availability from the supplier network, as for instance interviewees 3 and 9 pointed out:

> *In competence and resource planning it is about resources that are needed, not about are they own employees or not. (Interviewee 3)*

> *When considering the SC, the competence requirements and targets need to be defined to supplier and service provider as minimum requirement, what kind of qualifications and competences are expected. (Interviewee 9)*

It was also mentioned that it is important to consider capabilities and competence needs for the future in co-operation with suppliers and in their value chain. The needs in the companies and markets are changing, and it is important to proactively identify future competence needs, what is required from the supplier network in the future. It was also mentioned by one company that the employee-related risks and preparations using what-if- analysis are important to be done by the supplier in a co-operation with the buyer company to be able to know the risks and preparations for the cases of employee risks realize.

## 4.7 Requirements and specifications

Interviews pointed out that there are lots of requirements in the energy industry. In requirement management, it was mentioned necessary to identify requirements regarding the customer, contracts, sustainability and specific requirements set by authorities. Law requirements e.g. regarding safety and preparedness need to be understood as well. According to most of the companies it is necessary to understand the critical products, services, operations, systems, materials, suppliers and service providers as well as their connections and dependencies. When those are identified, prioritization can be done if needed in a crisis. It was as emphasized as essential to understand the condition of critical suppliers to ensure business continuity. Interviewees pointed out that it is important to understand business needs and requirements through the whole SC as well as what kind of competencies and qualifications are needed. It was seen essential the buyer company to have the capability to inform supplier what is needed, as for instance interviewee 2 pointed out:

> *It would be good if our needs in production would be asked by sourcing to get more cost-efficient solutions, and supplier decisions could be brainstormed together instead of just announcing the used supplier for the next 3 years. (Interviewee 2)*

According to most of the companies, it is critical to define requirements for sourcing at the beginning of the sourcing process and consider requirements in tendering. It was emphasized that collaboration between sourcing and business units is critical to be able to understand the internal requirements from service users and utilize their knowledge about critical issues in production. Interviews pointed out that it is necessary to identify critical issues, for instance raw material availability, to ensure essential issues affecting to competitiveness. Also, the visibility for future and possible changes were highlighted to be able to consider SC against those. It was seen necessary to document the requirements to agreements and monitor that those are followed by the suppliers.

**Asset management**

From an asset management perspective, the quality of the purchased components was highlighted to ensure the requirements from the operational level are considered in purchases. It was highlighted as well that the correctly defined criterion for sourcing is base for the successful asset management. It was emphasized by most of the companies that it is necessary to increase awareness about asset management due to its effects to SCRes.

According to most of the companies, predictive maintenance was mentioned as necessary in asset management which required on-time-maintenance with instructions. It was mentioned by one company that the responsibilities need to be clearly defined between the buyer company and suppliers to support successful asset management. It was seen necessary to share best practices and knowledge with the networks which support asset management in several companies. The quality of use was also mentioned as significant to ensure the long service life of devices which is monitored and alarmed by automated systems, as for instance interviewee 21 pointed:

> *We are monitoring the use that it is planned and agreed to prevent breaking devices by accident by using them wrongly. It is essential to follow the quality of the use. (Interviewee 21)*

According to most of the companies it was considered necessary to continuously monitor the conditions, make visual observations and follow up the failure rates. It was emphasized necessary that the instructions from the device supplier and the competence created by experience are used when implementing maintenance actions. According to several companies the systems and systems data were seen as essential to be used more efficiently in asset management to be able to notify risks and needs in production and processes proactively. Documented data from systems was seen as necessary for process quality measurement, to plan investments of new devices, to follow costs and for decision making. It was emphasized that there needs to be visibility in the processes and capability to share information with stakeholders. On the other hand, interviewees 11 and 16 pointed out that data ownership issues need to be clear and agreed with the suppliers:

> *Documentation is the most critical issue in asset management. (Interviewee 11)*

> *The quantity of data has been increased, and it is part of the assets. (Interviewee 16)*

**Safety**

It was emphasized by most of the companies that it is essential to build a culture that promotes safety and guides to avoid accidents, and it is considered in the whole SC. It was highlighted that there need to be safety principles in place. Insurances were also mentioned to be necessary from SCRes perspective. Safety was pointed out to have a necessary role in ensuring the high liability in production when unnecessary disruptions are avoided. Fulfillment of authority requirements in safety was seen necessary. It was highlighted that the buyer company needs to identify the critical safety places where the possibility of accidents is higher. The requirements need to be defined, as for instance interviewee 7 pointed out:

> *When the new power plant is built the occupational safety is taken into consideration. (Interviewee 7)*

> *The safety requirement definition for the SC what is requirement level for own employees and inside our company is taken forward to suppliers and*

> *required and monitored and followed up that the same requirements are implemented there as well. (Interviewee 7)*

Security report was highlighted as necessary to ensure that all the employees´ probity is continuously monitored. This concerns internal and external employees. Employees are also tested for alcohol before accessing the company area. It was highlighted that there need to be instructions and practices available for external service contractors and the company´s own personnel to ensure their safety. It was also considered important that instruction following is monitored. Personnel safety was mentioned as the most important issue when the maintenance is done in an active power plant, as for instance interviewee 22 pointed out:

> *We have paid attention to occupational safety, and it is continuous work. (Interviewee 22)*

It was mentioned that personnel competence and commitment to occupational safety are important to ensure resource availability and knowledge in disruptions and recovery from it. The orientation plans, trainings and qualification requirements need to be defined. Process safety was pointed out as important, which means the production without disruptions, good condition of devices and maintenance. It was emphasized by several suppliers that reserve production plants are essential to ensure a continuous process. According to one company, safety leaders taken into use to promote safety culture and go through the safety issues in process perspective.

**Requirement fulfillment by suppliers**

The requirement fulfillment and proactivity by suppliers were considered as vital. It was considered as essential that suppliers complete web orientation to be able to work in buyer company´s premises. Weekly supplier meetings during revisions were seen necessary to highlight safety. It was also highlighted that suppliers need to follow work instructions and requirements, follow law requirements in their work, and there needs to be traceability and documentation done accordingly, as for instance interviewee 16 pointed out:

> *The good local safety instructions for own employees but also partners as well as the monitoring the usage of instructions are the critical issues. (Interviewee 16)*

Interaction with the supplier was mentioned as necessary to get information about the conditions of devices and that the suppliers are making safety observations proactively. It was emphasized that the suppliers working in the byer company premises have a necessary role in making observations and reporting about essential issues to buyer company, as for instance interviewee 16 pointed out:

> *Interaction in safety issues is necessary to avoid a situation where we (buyer company) are always complaining about the supplier but also if the supplier notices some lack of safety in our operations, they can contact us actively and subscribe an observation into our system. (Interviewee 16)*

## 4.8 Supplier relationship management

SRM was seen as one of the most important ways to improve SCRes by several companies. Identification of critical suppliers was pointed out necessary by most of the companies. A standardized, systematic and proactive way to manage procurement and supplier relationships with a common management model from a long-term perspective was seen as essential by several companies. It was considered crucial to keep up continuous communication with suppliers and make sure that all requirements are well understood by the supplier, as for instance interviewee 20 pointed out:

> *In supplier management delivery ability and active dialogue are essential to be able to understand supplier´s capabilities better and thereby development can happen. (Interviewee 20)*

It was highlighted that it is essential to co-operate with financially stable suppliers who can provide high-quality resources. It was also mentioned that it is critical to verify critical suppliers´ solvency and resource availability. The suppliers´ reliability and liability to comply with regulatory requirements was pointed out as important as defining the supplier quality. Generally, supplier reliability was highlighted by several interviewees. It was emphasized by most of the companies that interaction, openness and

communication are essential in cooperation with suppliers. It was also seen essential to raise up problems, as for instance interviewee 6 pointed out:

> *Interaction and raising up problems are necessary because trust, interaction and collaboration are being tested when we have a problem situation. (Interviewee 6)*

The importance of the SRM tool was highlighted to be able to manage suppliers better by several companies. SRM system was seen essential to be able to collect and manage performance data as well as enabling the system integrations with ERP-system. The secured information flow and data transfer was seen as critical, which means that there needs to be ability and systems for secured information flow. The active supplier collaboration was seen as important by most of the companies. In several companies, it was emphasized that there are quarterly supplier meetings. The annual supplier management plan was raised up in discussions with one company. Development discussions were mentioned by most of the companies as essential to be done with suppliers at least once a year. It was considered important that supplier evaluations after revisions are important as part of supplier management, as for instance interviewee 20 pointed out:

> *A systematic process is necessary where the meetings are held regularly, supplier's performance is improved in delivery capability. By collecting data and making supplier evaluation, we can consider performance based on facts and start to consider how to improve. This way supplier's capability can be understood, and risk can be seen, which promotes the visibility and understanding to be able to prepare for the future and get predictability. (Interviewee 20)*

It was emphasized by one company that the SRM process was seen as necessary to implement with the business-critical suppliers. It was also highlighted that there need to be responsible contact persons defined for each supplier, targets and supplier management methods defined for each supplier. The importance of dialogue with the supplier during the contract life cycle was highlighted. Supplier Engagement Plan was found important to be created with the strategic supplier by several companies. It was emphasized by one company that the common trainings and quality follow-up meetings with the suppliers had been implemented before Covid-19. The suppliers were also involved in planning

meetings together with the buyer company. Interviewees pointed out that due to the pandemic the co-operation meetings had been minimized.

### 4.8.1 Organization

In most of the companies there was a category sourcing model already in use, or the implemention was ongoing where the sourcing and operational teams are organized in a cross-functional matrix team. It was seen important that the roles, responsibilities and job descriptions are clearly defined in sourcing organization in category plans. The importance of clear instructions and guidelines was highlighted by several companies. It was highlighted by one company that the internal integration is necessary when implementing the category sourcing model, as for instance interviewee 4 pointed out:

> *If we think about it generally that we can implement this change to category management so that the business units are joining. The internal integration is in a key position so that this can succeed. (Interviewee 4)*

In most of the companies the sourcing was responsible for the bidding and defining the general alignments for sourcing and supplier management. The operational units were responsible for orders and SRM in several companies. Generally, there are differences in the responsibility of SRM.

According to most of the companies, the categories are managed by the category managers who are responsible for their own category. In several companies, the category sourcing is managing the sourcing, instructing and supporting the employees in business units for purchases, as well as developing and creating guidelines for procurement at the general level. Category sourcing was stated to be responsible for the tendering and frame agreements in most of the companies. It was emphasized by several companies that the category sourcing team is responsible for supplier follow-up, as for instance interviewee 4 pointed out:

> *We are willing to start managing supplier relations strongly and more effectively during the contract period. (Interviewee 4)*

In most of the companies, the purchase orders were pointed out to be done in operational teams in business units or by the service providers. It was emphasized by several

companies that the foremen or other employees from the operational level are the main contacts for suppliers. It was considered important by one company that the new category sourcing model has involved more employees to supplier management to increase resilience.

### 4.8.2 Sourcing strategy

It was emphasized by most of the companies that it is important to integrate sourcing strategy to business strategy, which gives the targets and alignments for every unit. It was seen essential that the priorities and development for supplier management is done systematically based on the sourcing strategy.

It was emphasized by several companies that quality and costs are both essential in purchasing. The importance of quality was highlighted especially in critical products but also as the most important criteria in sourcing strategy. In addition, the value-adding by purchases was highlighted by one company which means that the competence from special fields and abilities to innovate are expected from the suppliers. The risk perspective was pointed out to be considered if there is one or several suppliers used. It was also emphasized that the content of agreements needs to fulfill the needs to ensure high quality. Renewal of sourcing strategy and resourcing to sourcing were seen necessary by several companies, as for instance interviewee 12 pointed out:

> *SCRes can be increased when more responsibility is given to suppliers, awareness increased, and rules for approved suppliers, as well as the frame agreements, are more systematically implemented. (Interviewee 12)*

**Decentralization**

According to most of the companies, it is important to decentralize the supply and have at least two suppliers to each SC. Due to the special procurement laws, the more expensive purchases are tendered, which is not allowing to have two suppliers in use at the same time or change suppliers easily, as for instance interviewee 4 pointed out:

> *We are restricted by the special procurement law, which obligates us to tender big projects, and it doesn´t enable us to have another supplier available at the same time. We had serious quality problems with one of the suppliers, but the change was not very easy to implement. There are some*

> *quality criteria in the SLA which enable the change, but when there is no other SC ready to be used, there is no alternative solution available. If ramping up there is an indefensible gap in SC before the new supplier is competent to produce anything. (Interviewee 4)*

According to the interviewees there are differences between companies in how significantly the procurement laws are restricting the procurement activities and tendering in the companies. Interviewees pointed out companies that the wide service provider network with material inventories is seen as important from spare parts availability perspective. When considering the business continuity, it was emphasized by most of the companies that there needs to be alternative SC available in case of disruptions.

### 4.8.3 Category sourcing

The category sourcing model is seen as essential in several companies when increasing SCRes. It strengthens the supplier management towards partnerships, promotes proactive planning together with partners and increase effectiveness. It was seen as important by most of the companies that in addition to sourcing knowledge, there is also substance knowledge from production available. According to most of the companies, the target in category sourcing is to find the best partners to create frame agreements for 2 to 3 years or continue collaboration with contracts valid until further notice, as for instance interviewee 11 pointed out:

> *Suppliers are aware that it is worth to invest in long-term cooperation. When they are proactive and take care of things well it is easier to increase prices when cooperation is smooth and uncomplicated. (Interviewee 11)*

The importance of familiarity in the responsibility area in the sourcing team was seen as essential to be able to be aware of the situation and manage the risks like Covid-19. Sharing knowledge between suppliers and buyer companies was seen necessary as increasing resilience by several companies.

### 4.8.4 Supplier classification

According to several companies, it was important to define supplier classification levels with criteria, for instance for approved, preferred, key, strategic and new suppliers. In one company, the classification is based on the ABC analysis of supplier purchase spend. It

was considered important that there need to be clear management models for every supplier classification level in place, including for instance the meeting cycles. According to one company, the promotion to the next supplier classification level, it is important to implement an audit to ensure that the requirements are fulfilled. It was emphasized that there is variation in supplier classification between different companies. It was considered crucial by most of the companies that there need to be alternative suppliers available for every product, as for instance interviewee 24 pointed out:

> *Target is that we have enough suppliers who are qualified and adequate to be able to compete them with prices. (Interviewee 24)*

According to one company, there need to be different management layers for strategic suppliers, key suppliers and small suppliers. In practice, this means that also the CEO of the buyer company and the key management contacts in strategic suppliers need to meet every now and then. Key and small suppliers were pointed out to be managed by the procurement team and the businesses in operations towards common goals, as for instance interviewee 4 pointed out:

> *It is as necessary as in our own team that suppliers are managed in a tight but fair manner, so they feel to be in the same boat with us rowing towards a common goal. (Interviewee 4)*

### 4.8.5 Agreements

The service level agreements are mentioned as important by most of the companies and updating of SLAs is ongoing in several companies. It was considered crucial by one company that whole SC functionality needs to be considered when creating frame agreements. Comprehensive agreements were mentioned as essential as risk management tools by most of the companies. It was emphasized that the validity needs to be ensured as well as there need to be service levels and sanctions defined in case the service level is not reached. The importance of service level agreements was mentioned as the most essential element, as for instance interviewees 13 and 11 pointed out:

> *Agreements are made to be able to know the operation principles if something (problems) happens. (Interviewee 13)*

*Service level agreements are the most critical in SC management and resilience. (Interviewee 11)*

According to one company SOPIVA-clauses are necessary to be used in agreements. It was considered important by one company that the SLA need to include the requirements for regular risk review for safety plans and obligations required by law. This way it is ensured that a regular review is done regarding risks, threats and other issues which might cause the disruption in the operations.

The importance of agreements was highlighted by the energy service department in NESA as a base for all the actions. All kinds of disruptions need to be considered in agreements, and there need to be terms and actions agreed in the case of those. Regarding disruptions, the usage of SOPIVA-clauses-model clauses incorporating preparedness issues, to be included in agreements-was mentioned as necessary to be used in the agreements.

According to most of the companies it is important to define the requirements already when the request for quotation is made. Several necessary requirements were seen related to quality, delivery capacity, responsibility and competitiveness in costs. According to several companies there are also requirements regarding the response time, competence, resource availability, competence and risk preparedness which are necessary to define in the agreements. It was also highlighted by most of the companies that the customer requirements are important to extend to requirements in SC. It was mentioned to be essential to define the continuity sentences into agreements with a maximum duration for the disruptions and sanctions if the duration is exceeded.

Several companies highlighted that it is important to organize kickoff meeting in the beginning of the collaboration with supplier to review the expectations, safety issues and agreement content carefully. Also, the follow-up meeting practice was mentioned as important to be agreed, for instance, on weekly, monthly or quarterly basis. It was mentioned that it is necessary to document all the agreed issues in agreements to be able to check them afterward. According to one company, it was essential to be defined if the agreement can be assigned forward to another company, for instance, in acquisitions.

It was also highlighted by several companies that in addition to the comprehensive agreement, it is important to define the targets and review the principles with suppliers to

promote successful collaboration and thereby increase SCRes. It was also pointed out by another company that SRM and practices are based on carefully defined agreements.

### 4.8.6 Tendering

It was emphasized by one company that critical issues need to be identified and added as criteria with scoring where the suppliers need to provide answers before getting the contract. It was considered as essential by most of the companies that the law requirements concerning public and special procurement need to be known to be able to implement tendering correctly. In addition, it was highlighted by several companies that due to law requirements the decisions about selected suppliers need to be done according to the lowest price, and it is difficult to define quality requirements. The changes in the supplier network were indicated as challenges and those were seen important to be done smoothly without any disruptions. This requires that the new supplier is well informed and familiar with the buyer company´s business and operations.

According to one company, the energy industry sourcing needs are based on projects of different lengths where the suppliers can change every two years due to tendering. It was seen necessary that tendering is made regularly to be aware of the price levels in the market and keep the suppliers alert. It was also pointed out that tendering promotes internal development since it required the sourcing to update the requirements what is needed. The third aspect was emphasized as the importance of long-term planning from 5 to 25 years and risk evaluation which are base for the supplier selections, operating principles and targets. It was also highlighted that if the requirements are not fulfilled, it is essential to be defined in the agreements how the agreement can be terminated if needed. Benefits were pointed out in regular tendering by one company. According to them regular tendering keeps buyer company up to date about the latest solutions in the market, what is the market situation and what we can require in the next tendering. It was con that regular tendering required by the law promotes continuous improvement and learning.

### 4.8.7 Partnerships

The role of the partnerships and the development of the partnerships are seen as important by several companies. It was emphasized that identification of essential suppliers and committing them is necessary to promote development. According to most of the

companies, the big and small suppliers can be strategic and critical, which is important to define. Incentive rewarding for partners was also highlighted by several companies when implementing proactivity with the partners and to increase resilience and delivery accuracy. The partners´ competence is indicated to be important. This was pointed out as a necessary element to being able to compete with other bigger companies at the industry level and ensuring the needed service level availability. This was highlighted especially in maintenance resourcing from the service provider. Their trainings and competence need to be up to date but also local knowledge is needed, as for instance interviewee 25 pointed out:

> *When the subcontractors are used and bids are requested we can exploit the supplier's competence. (Interviewee 25)*

According to most of the companies, integration and visibility with the chosen partners are important. Partnerships with suppliers enable proactive risk identification and corrective actions when the responsibility is given to the partner. According to several companies, the strategic partnerships are difficult to achieve in energy industry sourcing due to public procurement law requirement to implement tendering. It reduces the suppliers´ willingness to the development and thereby prevents the visibility realization. Reliability was pointed out necessary by most of the companies when building supplier cooperation. The long partnerships were seen as important to build a trust, as for instance interviewees 2 and 20 pointed out:

> *It is very essential to have a reliable supplier who understands our needs and there is flexibility from both counterparts. (Interviewee 2)*

> *The meaning of partnerships is large. Proactivity needs to be required so that supplier informs e.g., the Covid-19 effects on to the workforce or component availability. If the capability is not enough and the collaboration is not working, we will suffer. It is essential that you are capable of manage and get the needed information to be able to anticipate. (Interviewee 20)*

The importance of partnerships was also mentioned in Covid-19 pandemic when the material availability was ensured by reliable supplier. According to several companies open discussion, mutual trust, dialog and atmosphere are important enablers to get risks and development needs from the supplier side more visible. Interviewees pointed out that

trust is an essential element. The continuous interaction and feedback about capabilities increasing resilience were seen as important. The feedback sessions with the suppliers and internal stakeholders were indicated important by most of the companies, as for instance interviewees 4 and 25 pointed out:

> *We would create an atmosphere where the supplier don´t need to be afraid of thrown out or not selected if they told the risk and we would have a trust to build the partnership. Everyone knows that there are risks in any case but hiding them under the carpets is not building and strengthening the long-term cooperation. (Interviewee 4)*

> *It is just about developing SCRes when the feedback is given and received. (Interviewee 25)*

### 4.8.8 Supplier development

According to several companies, the supplier audit model and audit plan were seen as essential to be able to increase the audits for most important strategic suppliers. Therefore, supplier auditing competence was seen necessary to be developed in category sourcing. Still, it was highlighted that supplier management could not be outsourced to the HSEQ® cluster. Systematic HSEQ® audits were pointed out as essential by most of the companies to promote supplier's development, to improve the quality of supplier performance and thereby to improve SCRes with the suppliers, as for instance interviewees 25 and 16 pointed out:

> HSEQ® *cluster has a significant role in SC development. (Interviewee 25)*

> *Earlier, we have done audits for fuel suppliers independently, but now the* HSEQ® *cluster provides a standardized auditing model, and we don´t have to audit the suppliers separately. (Interviewee 16)*

There was seen development potential in several companies to increase the supplier audits, especially to partners, and promote continuous improvement using, for instance, scorecard targets. According to most of the companies, it is important to train suppliers for HSEQ® audits. HSEQ® audits were indicated to improve suppliers´ continuity management as well. Several companies pointed out important that there was evaluation

tool for the service provider which is used after projects to evaluate performance and to identify the development needs. It was emphasized that it is essential to give real-time feedback to the supplier in case of quality defect or delivery delay to be able to develop. Incentive model was seen as necessary also when promoting the development and open discussion. It was emphasized that the open discussion is essential criterion for the strategic supplier.

### 4.8.9 Supplier risks

Interviewees pointed out that active interaction with suppliers is essential to be able to follow up situation and for proactive risk management. It was also emphasized by several companies that there is improvement needed how proactively suppliers identify and inform the buyer company about the possible risks in their operations. According to most of the companies the supplier management need to be developed more from active to proactive management. It was considered by one company that the risk evaluation is done once a year as part of the category plan. The risk evaluation includes risk identification, size of the risk, risk effects and action plans. It was considered important by one company that the risk management tool is being created where the most important products and suppliers are identified based on the portfolio analysis.

The risk management manual was mentioned as important by one company to be done for specific sourcing category which will be duplicated to other sourcing groups. Risk management work was mentioned to be done in co-operation with the supplier when the risks are identified, evaluated and mitigation plans are done together with the supplier. It was also pointed out important that the production maintenance and repair are planned together with the supplier to be able to use their expertise.

It was mentioned that it is necessary to require risk analysis and preparation plans from suppliers in case of personnel risks or machine failures for instance. It was seen that more attention should be paid to risk evaluation and to plan alternative SCs. The security checks were also mentioned by several companies to be necessary for the energy industry to minimize risks. It was emphasized by one company that there are several formal documents including risk mapping which supplier need to fulfill and update regularly, for instance, in plant construction projects.

It was mentioned that suppliers have been asked to inform their preparation plans and weekly update during Covid-19. Generally, the common meetings and active interaction were mentioned by most of the companies, which have been done regularly to prevent problems in SC. In addition, the requirements and corrective actions have been required, and those were monitored. It was considered crucial by one company that they require similar level plans from the suppliers what they have in their company for instance in resource management. It was highlighted by one company that the requirements for risk preparation are essential to require from the supplier before the agreements are done to avoid discussions about additional costs regarding the preparation work.

According to several companies, the reliability of suppliers is ensured by checking the reports about finance and taxes even 24/7. There was seen variation between companies. According to one company resource situation and other risks are reviewed once a month with the supplier. According to most of the companies, the post-contractual risk follow-up needs to be improved at the general level. Several companies indicated that they are having or implementing automated 24/7 financial follow-up systems. Audits are mentioned by several suppliers to be an essential point when the risk preparedness can be discussed. Still, it was mentioned by one company that the risks are not seen widely enough. According to one company, the reclamation process was pointed out as the most important tool in risk management, as for instance interviewee 13 pointed out:

> *I see the reclamation process as one extremely important tool when we are talking about risks and risk management. We are striving to develop issues and correct the root causes to ensure that the mistakes won´t happen again. (Interviewee 13)*

Interviewees pointed out that larger suppliers are better prepared for the risks than small suppliers. It was emphasized that the bigger suppliers create business Continuity Plans more systematically. It was considered important that the availability of a Disaster Recovery Plan is one of the requirements in public tendering. According to one company, they have found it important to organize a preparedness team which has prepared instructions for different risk scenarios. The instructions were shared with partners, which had increased the preparedness.

It was seen important that the supply network is well-known, and there was indicated development needs in several companies. It was highlighted that customers could even

require information about the supply network. It was emphasized that agreements define the buyer company has right to audit, approve or reject the suppliers. On the other hand, it was also mentioned that the suppliers are responsible for their own chain. It was emphasized that supplier audits for critical suppliers are important to follow the supplier development and evaluate the progress. It was mentioned that open and visible discussion is vital with the suppliers to get information about the risk preparedness. Visibility through common meetings was pointed out important by several companies, as for instance interviewee 13 pointed out:

> *When the suppliers´ value chain is identified and known and if we start to see some risks for instance delivery delays, we can prepare for the risks and ensure the SC functionality by identifying the weaknesses and do something about those. (Interviewee 13)*

### 4.8.10 Material and service availability

Proactivity in sourcing and thereby preparations in case of delivery problems was pointed out as essential by most of the companies. The material and service availability is ensured by using several suppliers and service providers if possible and available. Interviewees pointed out that the outsourcing of maintenance and service is a challenge since the service providers are not able to provide service just in time when needed.

It was emphasized by most of the companies that it is important to have a discussion about risks with all the stakeholders in the planning phase to ensure the availabilities in time, for instance, in spare parts. Interviewees pointed out that their own role as a small buyer company in energy markets is a challenge when considering material availability, for instance. The raw material availability and price fluctuations were seen as challenges. Criticality classification is considered as essential by several companies to get an understanding of critical components and services, as for instance interviewee 21 pointed out:

> *When the high-risk suppliers are identified, we know the approach that they are connected continuously. (Interviewee 21)*

Proactivity was highlighted with these as it is seen essential to agree to service level agreements and make reservations for products and services. In addition to these, it is important to update criticality classification regularly. The raw material availability and real time flow were pointed out as critical by most of the companies. The material availability was seen as critical by several companies due to long delivery times. The spare parts availability for maintenance operations is seen as critical by all companies, and that is secured in some companies by keeping up emergence storages for 3 to 6 months and own spare part storages for critical components and processes. The spare part pools are notified as one securing option for spare parts where most of the companies pointed out they are participating. The supplier can be committed to keeping the spare parts in inventory upon the payment as well. The importance of emergency inventory was highlighted by several companies as it reduces risks of disruptions in material flow to production and thereby the production disruptions, as for instance interviewees 8 and 7 pointed out:

> *The main components are kept in the storage by the contract service provider. In addition, we have crisis inventory, including components that are not available from any supplier with a short delivery time, and which are urgently needed in failure situations. (Interviewee 8)*

> *Critical spare parts need to be kept in our own inventory. (Interviewee 7)*

The development of spare part warehousing was seen as necessary by one company to be able to take advantage of partnerships and common spare part warehouses with the competitors. It was considered important that collaboration with competitors in spare part management could support asset management purposes as well. It was also emphasized that the inventories and ownership of them are essential to be reconsidered due to component import for new solution business from Asia due to high capital tied into inventories.

The service availability was seen as critical by most of the companies due to long delivery times. It was also pointed out by one interviewee that the service providers need to be able to provide fast service resources in case of critical maintenance need. Flexibility by the service provider was also seen as essential. The fast service is ensured by defining the

response time in the Service Level Agreement (SLA). This can be supported by planning the future work together with supplier and buyer company and by continuous collaboration.

According to most of the companies, there is a challenge in service resources availability by the service provider as expected. This is seen as a challenge due to weakening effects to production and plant´s liability. It is also pointed out that the competence of service providers is critical, and if there are no competent employees available, it is causing a delay for repair and weakens the quality of service. The availability of service in required lead time was indicated risk by several companies which need to be prepared. The agreements and plans based on that were seen as essential in that perspective to ensure service needs.

## 4.9 Visibility

Visibility and understanding of the SC process was pointed out as critical by most of the companies when considering business continuity. All of the companies said that they have defined processes and created process charts at some level, or they exist but need to be updated. Some of the companies also emphasized that they had done the process charts in co-operation with the service providers. In some companies, there are process owners for each process. It was considered crucial by several companies that it is essential to know the suppliers´ value chain completely and its weaknesses and capabilities. Knowledge of the markets and industry was pointed out as important to be able to know the value chain.

It was emphasized by most of the companies that the lack of system capability and ERP systems, are weakening the process visibility. Due to a lack of data, there is no supplier data available. According to several companies, systems and processes need to be duplicated in case of system disruptions. Operating models and instructions were considered as essential by most of the companies to keep up the ability to operate in all situations. Interviewees pointed out that the lack of instructions and operational models is weakening the process visibility. Documentation of basic tasks was also seen necessary by most of the companies to minimize the hidden information and to enable the work by a substitute.

The importance of information sharing and communication with internal and external stakeholders was highlighted by most of the companies. It was seen important that the information e.g., about the failures is shared immediately with the stakeholders. They also highlighted the usage and development of artificial intelligence (AI) from the beginning of the value chain to improve visibility and thereby increase proactivity. Interaction and open discussions were highlighted by several companies. The communication between buyer and supplier was highlighted as critical but also a challenge. According to one company, the communication was indicated to be problematic because of the cultural issues where negative topics are avoided in the discussions. The proactive interaction, especially with critical suppliers, was seen as important by most of the companies. Defining roles and responsibilities were mentioned by one company to be necessary. In practice, the responsibility matrix for corporate safety has been done to ensure that the responsible persons for service provider and buyer company are known internally and externally.

## 4.10 Results synthesis

According to empirical study findings and literature review the answers can be partially given for the research questions (3) what capabilities are critical to be considered to ensure high SCRes in the energy industry in Finland and (4) how to improve SCRes in the energy industry in Finland. When considering SCRes capability capabilities based on the empirical study, critical capabilities are identified (Table 5). These capabilities are essential to be improved SCRes in energy the industry in Finland by systematic SRM in collaboration with suppliers.

Table 5. SCRes capabilities from the empirical study.

| SCRes capabilities | Description |
|---|---|
| **Continuous improvement** | Continuous improvement needs to be part of work. For instance, root cause analysis, corrective actions, monitoring and documentation are base for continuous development. By proactive risk identification and observations development potential can be identified proactively. Joint workshop and development team implementation with members from different organizational levels and suppliers are essential to boost the development. HSEQ® audits, best practice sharing, proactive observations by suppliers and feedback to suppliers are important to increase resilience. Supplier early involvement in, e.g., strategy work and development are promoting development and increasing commitment. |
| **Continuous performance measurement** | Supplier performances need to be followed continuously. Several performance measures in buyer company, e.g. liability, additional costs, recovery times, safety observations and quality defects can be used for SCRes |

| | |
|---|---|
| | measurement. Suppliers' economic situation is a critical measure to follow. Measuring the satisfaction surveys, SLA conformity and availability of risk and continuity plans gives information about suppliers' compliance. HSEQ® assessment results can be used to measure supplier quality. |
| **Financial stability** | Critical supplier´s financial condition is important to be followed, e.g. by suppliers solvency, turnover and profit. The suppliers´ stability and financial condition need to be followed up continuously 24/7 by the buyer company or by external service provider. Financial stability is important criterion when choosing the suppliers for collaboration. |
| **Innovativeness** | Innovativeness and eagerness to the development and innovations is a lifeline for a company. It is promoted by encouragement and involvement, e.g., for strategy work and development activities. |
| **Internal and external collaboration** | Collaboration with internal stakeholders is necessary to understand the needs and critical issues. Disruptions can be prevented by collaboration in whole network. Collaboration through pools organized by NESA and network development projects are important to promote continuous improvement. Collaboration is needed through whole SC and also with the other companies in energy industry field e.g. in mode of common trainings. Preparedness through whole SC requires collaboration. |
| **Long-term planning** | Long-term planning, anticipation and implementation of the plans is necessary in wide perspective in the company. Mutual planning with suppliers is necessary e.g to define common targets and identify risks. Long-term planning is based on data availability from ERP systems. |
| **Proactive risk and business continuity management** | Proactive, long-term planning is necessary when decreasing the risks and ensuring continuity. Proactive risk preparedness and business continuity plans combined need to be considered from the whole SC from every critical supplier. The Business Continuity Plan is important to require from suppliers. The BCP includes: risk identification through SC, risk evaluation, risk analysis with risk probabilities, mitigation plans, effects evaluation, management and communication models, defined roles and responsibilities, employee trainings, virtual training environment usage, practical trainings and simulations with suppliers. Risk preparedness trainings are done in collaboration with suppliers. The pools e.g Power and District Heating Pool organized by NESA can promote business continuity plan creation. Risks are considered widely from the beginning of SC and continuously evaluated in whole SC with the proper resources and common SRM systems. Proactive and continuous follow-up of suppliers using assessments, development discussions and active supplier management are necessary to anticipate the future risks e.g. in material availability. Collaboration development and continuous brainstorming with suppliers reduce the risks. |
| **Resource and competence management** | Resource availability from the supplier needs to be planned proactively in co-operation with the supplier network. Management of employee competences, deputy persons availability and proactive resource planning in the long term are needed to ensure labor availability. Orientation of new employees takes time, and there are obligatory qualifications. Thereby there needs to be a system to plan and manage qualifications on the supplier´s side. It is important to define the quality requirements already in the agreement to ensure that there are competent employees available. Cross-competence increases SCRes by strengthening the employee competencies. Future competence needs are necessary to define in collaboration with suppliers to enable competent resource availability. Social capital is increased, e.g., by knowledge sharing with supplier network which increases SCRes. |
| **Requirements and specifications** | There are numerous requirements in the energy industry to be defined and communicated to suppliers. Law requirements concerning safety and preparedness, qualifications and competence requirements, as well as quality, data management, safety and insurance requirements, are essential to be defined in collaboration with internal business units. Future needs are important to be considered. Understanding e.g critical products and materials enable the prioritizations in crisis. Requirements need to be fulfilled by suppliers. |
| **Systematic SRM** | A standardized, systematic and proactive way to manage SRM in the long term is essential. Continuous interaction SRM management models build |

| | |
|---|---|
| | collaborative supplier relationships. Development discussions, supplier evaluations and dialogue with suppliers are necessary during the whole lifecycle of the relationship. SRM tools ensure data availability and performance management. Partnerships, integration and visibility are essential in relation to resilience to enable proactive risk identification with corrective actions. In the energy industry, partnerships are difficult to achieve due to law requirements for regular tendering. Mutual trust, open discussion and feedback promote the visibility to development needs and risks on the supplier side. Category sourcing strengthens supplier relationships towards partnership and promotes proactive cooperative planning. Proactivity is an important element in procurement. The alternative supply networks, decentralization and criticality classification enable proactive planning and actions. Law requirements need to be known and followed. Spare parts are critical in the energy industry, and the availability needs to be ensured by emergency inventories. Service is needed on short notice, which requiring flexibility from the supplier and common planning with the buyer company and supplier. Requirements are defined from several perspectives, and targets are set, which are documented to agreements. Sourcing strategy and business strategy are integrated to ensure the targets are in line. Agreements are based on the carefully planned requirement specifications and using SOPIVA clauses. Supplier audit model, audit plans and audit competence are important elements in supplier development. The reclamation process is the most necessary tool in risk management. It is essential to know the supply network to be able to accept the suppliers. |
| **Visibility** | Visibility and understanding of processes support the business continuity. Suppliers´ value chain needs to be known completely. The visibility requires system capabilities, e.g, ERP and SRM systems. Visibility is increased by the documentation of instructions and operational models. Proactive information sharing, communication, interaction and open discussion with suppliers, as well as clear roles, are essential enablers for visibility and thereby for SCREs. |

# 5 DISCUSSION

The target of this research was to define how SCRes can be managed and developed in the energy industry in Finland by defining the critical capabilities to ensure SCRes and how it can be managed and improved. This chapter includes a discussion about the findings based on empirical study and literature review, as well as scientific and managerial implications. Answers for research questions (1) how can SCRes be defined in an energy industry context and (2) how to manage SCRes are summarized in this chapter. The research questions (3) what capabilities are critical to be considered to ensure high SCRes in the energy industry in Finland and (4) how to improve SCRes in the energy industry in Finland are also completed as managerial implications.

The findings from this research confirm the definition of SCRes and management of SCRes as they are defined in literature synthesis (chapter 2.4). Based on literature and empirical study, the key in SCRes is to proactively ensure business continuity, risk tolerance, adaptability and fast recovery in case of crisis, disruptions and every situation. SCRes capabilities in the energy industry needs to be considered through the whole SC and build with intraorganizational and interorganizational capabilities by improving intraorganizational and interorganizational capabilities. Intraorganizational capabilities are built in companies internally and interorganizational capabilities are built in collaboration with the supplier network. All the risks can not be prevented and therefore capability to recover fast from disruptions is needed from the whole SC in every level (Jesse et al. 2019) to mitigate the effects on the business performance. The critical capabilities in SCRes are introduced in the literature and empirical study synthesis (chapters 2.3 and 4.10) Based on the research these capabilities need to be improved and better implemented in SCs in the energy industry companies in Finland. The SCRes is managed and improved by SCRes capabilities through systematic SRM to ensure tolerance against crisis and recover fast from those. In the energy industry the importance of proactive preparation is essential to increase SCRes.

Based on the findings from the empirical study, the BCP framework (Fani & Subriadi, 2019) can be updated as an energy industry specific BCP (Table 6). The findings from the research are aligned with the original framework, and Table 5 reinforces it with energy industry specific findings. The joint trainings and simulations are essential to be done with suppliers and other partners to ensure preparedness and SCRes through the whole SC. The usage of the BCP template created by NESA and instructions for suppliers are

completing the BCP framework for the energy industry. It is essential to keep up the continuous BCP process to be able to update plans.

Table 6. Updated BCP process for the energy industry based on empirical study.

| BCP Phase | Content (Fani & Subriadi 2019) | Findings from the empirical study |
|---|---|---|
| **1. Determination of business continuity management needs** | Defining the objectives and scope<br>Establishing a committee and defining committee responsibilities<br>Defining related parties and resources<br>Creating communication flow | Defining requirements e.g. law, competences<br>Defining criticalities e.g. products, suppliers, services<br>Defining future needs |
| **2. Budgeting** | Defining resources, time etc. other cost-effective elements<br>Creating cost calculations and budget plans | Defining resources, time etc. other cost-effective elements<br>Creating cost calculations and budget plans |
| **3. Risk analysis** | Documenting, analyzing and evaluating risks | Risk identification through SC<br>Risk analyzing and probability evaluation<br>Risk mitigation plans |
| **4. Business impact analysis** | Identifying, documenting and prioritizing business functions<br>Collecting IT data from processes<br>Defining disturbance tolerances<br>Analyzing disturbance impacts<br>Defining recovery times | |
| **5. Business continuity strategy** | Defining preventive, action, recovery and corrective strategies | |
| **6. Disaster Recovery Plan DRP** | Documenting information | Defining management and communication models<br>Defining roles and responsibilities<br>Defining priorities |
| **7. Employee trainings** | Defining training requirements<br>Defining trainings<br>Implementing trainings | Defining training requirements<br>Defining trainings<br>Implementing practical trainings<br>Virtual training environment usage |
| **8. Collaborational trainings** | | Implement practical trainings and simulations with suppliers and other partners |
| **9. Instructions for suppliers** | | Defining instructions to suppliers<br>Usage of BCP template created by NESA<br>Usage of checklists |
| **10. BCP testing** | Creating testing practice<br>Testing<br>Documenting findings and testing results | |
| **11. Business continuity review** | Defining review period<br>Defining review mechanism<br>Implementing periodic review<br>Planning review and update | |

## 5.1 Intra-organizational capabilities

The buyer company needs to know its **internal requirements and needs** to be able to define them for sourcing now and in the future. The criteria with e.g. competence requirements, are defined for the approved suppliers. In summary, it is necessary to understand own business and its requirements based e.g. on the laws, quality and needed competences comprehensively, to be able to communicate those to suppliers**.** Defined specifications need to be documented in agreements. Internal collaboration with different business units is necessary to ensure the correct specifications. When needs are better known by the supplier, it reduces the risks and promotes proactivity from the suppliers' side to fulfill the requirements. Carefully defined specifications create the basis for the successful purchasing process and reduce risks for unclarities in the later process phases, as it is stated by van Weele (2010).

**Proactive risk and business continuity management** in the long-term as a continuous evaluation and improvement process is the base for the risk management where the whole SC needs to be considered widely. There need to be plans available in the buyer company and those need to be required from the supplier to ensure standard preparedness level. As stated by NESA (2020), continuity management is continuous activity regarding the whole SC, which increases employees' abilities to operate in crisis and to minimize the costs and damages caused by disruption.

**Business Continuity Plan** is a critical tool for risk management in the energy industry, as stated by Luskova and Leitner (2020). For the crisis preparations, the priorities and criticalities, e.g in suppliers or services, need to be clarified. The usage of risk preparedness checklists created by NESA is important to utilize better into use and create those also for the suppliers. NESA promotes the development of risk preparedness by providing the risk preparedness checklists, which are important to utilize into use in buyer company and in supplier. Participation in pools organized by NESA increases the the preparedness capabilities, and thereby resilience. Several risks are critical, e.g. quality and workforce availability, when considering the supplier. It is important to understand the risks already from the beginning of the suppliers´ value chain. Successful risk management requires that the roles and responsibilities are clear. Sourcing agreements with comprehensive terms and conditions are essential in risk management. There needs to be the capability to identify the critical competencies and key employees to ensure the

deputies and promote cross-competence development in the organization. Business continuity planning is necessary to implement independently in the supplier and buyer, but it is essential to provide support to the supplier e.g. in a mode of instructions.

**Resilience strategy management** needs to be considered already in the new product development phase to ensure standardized products and the availability of several suppliers. According to Business Finland (2021), business strategy needs to include a resilience perspective and enable agility and flexibility in the company. As it is defined by Emenike and Falcone (2020), the defined resilience strategies are concentrating mitigation or recovery strategies which usage depend on the company priorities. Based on the empirical study, those strategies are needed in the energy industry due to the importance of preparedness and the criticality of the energy industry. The strategic change in the energy industry towards renewable energy usage requires adaptability.

**Resource and competence management** perspective critical tasks need to be identified. Companies need to be aware of their individual needs in competencies, resources and long-term business planning. Buyer company and suppliers need to have their own strategy and vision for the future which need to be synchronized. Cross-competence, e.g. by job rotation, needs to be built in both buyer and supplier organizations to promote flexibility. The competence development follow-up system ensures visibility to competence management. The competence development is increased in buyer company and suppliers by collaboration with the HSEQ® cluster, which aims to increase HSEQ competence in the companies. (HSEQ 2020) Resource and competence management are important in Business Continuity Management when creating and increasing SCRes (Business Finland 2020; Fani & Subriadi 2019).

**Continuous improvement** with root cause analysis and corrective actions in a proactive and systematic manner, are decreasing the risks and promoting the improvements, which is needed in buyer company and supplier to increase resilience. Continuous improvement is needed in every operation as it supports continuity management (NESA 2020). Employee involvement by giving responsibility and activity in development networks promotes the ideas, innovations and networking. Employee's activity and motivation for development are essential. Participation in development groups organized by LOGY is promoting the development and new ideas. The progress of development is followed by continuous monitoring of chosen KPIs.

**Systematic, standardized and proactive SRM is** essential to improve SCRes. The supplier management model usage for business-critical suppliers in the long-term perspective is essential. The continuous interaction and communication enable the visibility of needs, capabilities and problems in SC. Co-operation meetings and common trainings are an important part of risk preparedness. Risk mitigation, quality and visibility are increased by clearly managed SRM (Ruuskanen 2021; Turnbull-Smith 2021). The risks and business continuity need to be considered in SRM as well. The material and service availability is ensured by using several suppliers, decentralization and emergency storages.

**Partnerships** are promoting common proactive planning, knowledge sharing between internal and external stakeholders as well as promotes internal integration. Long-term supplier relationships are promoting faster recovery from disruptions. (Jain et al. 2021) The critical suppliers are essential to get committed to promoting development and proactivity, which can be supported by incentive rewarding improves supplier proactivity.

**Sourcing alignments** are based on the business and sourcing strategy. The sourcing strategy, supplier classification and management model planning based on those clarifies the priority of each supplier and used management practices. The sourcing strategies and management models enable SC to recover faster from disruptions faster (Jain et al. 2021). Quality and value adding are important criteria in sourcing in the energy industry. In tendering the laws need to be known to implement tendering correctly. The quality criterion based on the specifications is included in tendering. Correctly defined specifications are the basis for the successful purchasing process (van Weele 2010).

**Comprehensive sourcing agreements** with comprehensive terms and conditions are important risk management tools and those need to be documented in written form. The SOPIVA-clauses are essential to be used in the agreement to reduce the risks. The usage of SOPIVA-clauses in agreements are supporting business continuity (NESA 2021). When the agreements are defined the whole SCs functionality need to be considered by defining the specifications. A kick-off meeting at the beginning of collaboration ensures that the requirements and agreements are mutually understood and implemented. It is important to define all the terms of purchase in the agreement to ensure the consensus (van Weele 2010) and shared understanding between buyer company and supplier.

**Resilience performance measurement** using KPIs enables proactive risk management and risk mitigation (Werner et al. 2020). The supplier performance and company performance are linked together (Turnbull-Smith 2021), which justifies the importance of SCRes performance measurement. Buyer company and supplier can evaluate own maturity by Best-In-Class tool provided by LOGY, as stated in literature (Werner et al. 2020). The used KPIs for resilience measurement depend on the company´s strategy. From the resilience perspective, it is important to implement supplier-specific measurement e.g. for defects and service lead times.

**Long-term planning** is essential in the energy industry. As it is stated in the literature (Business Finland 2021), resilience requires systematic planning to be able to withstand against a crisis. Buyer company and supplier need to have their own targets and plans defined for the long-term period of 5-25 years. History data availability from ERP and HSEQ-systems is the basis for the planning.

**A flexible and innovative organization** is essential when building SCRes (Scholten et al. 2019). Employee involvement in planning and development increases innovativeness. Flexibility is built by increasing e.g. cross-competence. Open culture creates the basis for the organizational development to increase SCRes.

**Financial stability and strength** are essential capabilities of suppliers, and those need to be used as criteria when suppliers are chosen for collaboration. Critical suppliers´ financial conditions need to be followed up 24/7 by an external service provider or by the buyer company. Supplier´s financial situation can be monitored by following e.g solvency, development of turnover and profit (van Weele 2010). As stated in literature (Ali et al. 2017; Werner et al. 2020), the financial strength is one of the main capabilities in resilience creation. Financial stability is essential to be reached for the suppliers and the buyer company. SC finance need to be considered through whole SC to reach optimal cash-flow in long-term perspective as stated in literature (Jia et al. 2019) and thereby decrease financial risks (Tate et al. 2019)

## 5.2 Inter-organizational capabilities

**Proactive risk and business continuity management in the long-term** is developed by the collaboration between the buyer company and supplier it to find ways to mitigate risks

and improve preparedness. Open discussion and mutual trust between buyer company and supplier make risks more visible. The reclamation process is essential in risk management as it promotes root cause analysis and corrective actions. In addition to proactive risk identification, suppliers need to inform the buyer company actively about the risks, and the atmosphere needs to support the open discussion. By common risk mapping, observations round, continuous follow-up and assessments visibility to risks are increased. Continuous, common risk scenario practicing enables the preparedness in case of disruption. The Business Continuity Plans are important to be done in collaboration with suppliers to ensure the needed preparedness level (Business Finland 2021).

**Network collaboration** is necessary with the whole SC and companies in the energy sector to improve preparedness and to build SCRes. It is important to develop interaction to network interaction to enable continuous improvement and implement development projects with suppliers. The collaboration in pools organized by NESA promotes versatile collaboration. As defined by Ruuskanen (2021), network collaboration strengthens the SRM, and thereby risk management, and minimizes disruptions. Collaboration benefits to SCRes are significant as it is stated (Scholten et al. 2019) that dynamics between organizations promotes flexibility and collaboration. Collaboration is the main element for building resilience (Werner 2020). Risk and business continuity management, continuous improvement, competence management and long-term planning are important to be done in collaboration with suppliers. According to Business Finland (2021) the risk management is important to be done in collaboration with suppliers. In addition the collaboration risk scenario practicing in co-operation with supplier and buyer company is stated as essential.

**Visibility** can be increased by defining processes in cooperation with suppliers when it gives a perspective to suppliers´ value chain, its weaknesses and capabilities. Proactive information sharing, interaction, open discussion and clearly defined roles and responsibilities increase the visibility as well. There needs to be visibility to suppliers´ value chain as the visibility to processes and routines develops resilience (Scholten et al. 2019). Information sharing with internal and external stakeholders is essential, and it enables the fast actions in case of crisis, development and innovativeness. Shared SRM tool availability for the buyer company and supplier network enables visibility about risks in the whole network, which is also stated in the literature (Ivanov & Ajay 2020) as well.

The current Covid-19 pandemics have fastened the development of system visibility. (Sheffi 2021)

**Proactive, long-term resource and competence management** in collaboration with suppliers is a critical part of the proactive crisis preparedness to ensure competent resource availability in Finland (Business Finland 2020). The critical tasks and positions need to be identified to ensure business continuity from the resource perspective but also identified the future competence needs in collaborations with suppliers. In the energy industry, competence development takes time, and there needs to be qualified deputy personnel available in every situation. Collaboration with suppliers is essential when competence is increased and developed. The competence development needs to be based on plan. It is necessary to review and update the qualification requirements to ensure the validity. Based on the literature (Bento et al. 2021), the resources and competences with knowledge create resilience as part of organizational resilience. When considering the competence development, the collaboration with the whole SC is important (Scholten et al. 2019)

**Continuous improvement** requires collaboration with internal and external stakeholders. The joint workshops and development teams with suppliers are necessary for development. The employee and supplier involvement in strategy work increases the common discussions. Supplier early involvement and usage of external resources in development is promoting the improvements by new innovative ideas. Real-time feedback giving to between suppliers and buyer company is important for continuous improvement. Systematic HSEQ® audits promote critical suppliers' development and continuous improvement by identifying the development needs. The supplier assessments, interaction and feedback, are promoting the continuous improvement (Turnbull-Smith 2021). Jounila et al. (2020) highlighted the importance of HSEQ® audits as a promoter of continuous improvement in supplier companies. Based on the literature, the continuous improvement is also promoted by self-assessment using PSK8404 standard (PSK Standards Association 2015).

**Continuous resilience performance measurement** is an essential part of continuous improvement to identify the development needs, implement corrective actions and follow up the progress. The continuous follow-up of key measures is needed to follow up the supplier´s situation. As stated in literature (Bento et al. 2021), the resilience can be

reached by continuous monitoring. The availability of measurement data from ERP or SRM systems ensures the accountability of the data. It is essential to review the data-based measures from supplier and buyer company perspectives to compare the results. The history data availability enables the forecasting for the future, e.g. in financial measures (van Weele 2010).

**Long-term planning** with anticipation and implementation plans creation in collaboration with suppliers is needed in several perspectives. Planning is essential in resilience strategy creation (Azademan & Dooley 2021) as long-term planning is needed regarding all the SCRes capabilities and operations through the SC in the energy industry.

## 5.3 Scientific implications

The findings of this research complement earlier research by emphasizing critical intraorganizational and interorganizational capabilities when building SCRes in the energy industry in Finland, as discussed in subsections 5.1.1 and 5.1.2. The management and improvement of those are considered as part of Supplier Relationship Management. This research combines the latest research findings and wide empirical study in energy industry companies to define the intraorganizational and interorganizational capabilities and management of those in the energy industry in Finland.

## 5.4 Managerial implications

SCRes in the energy industry is strongly based on proactive risk and business continuity management and implemented in collaboration with internal and external partners. It is important to promote the development of intraorganizational capabilities in companies since those create the foundation to build interorganizational capabilities in collaboration with buyer company and supplier. The capabilities are presented in Figure 3 and content is described with detailed elements in Appendix 5. Building SCRes requires long-term planning and resilience strategy to enable proactivity and anticipation which are essential in the energy industry. SCRes building requires clearly defined requirements and specifications which require internal collaboration to identify different needs. Business continuity management and specifications are creating the key for improving SCRes. Continuous improvement and assessments keep up the improvement of SCRes which is

managed by SRM. Interorganizational capabilities need to be built to ensure high SCRes through the whole SC.

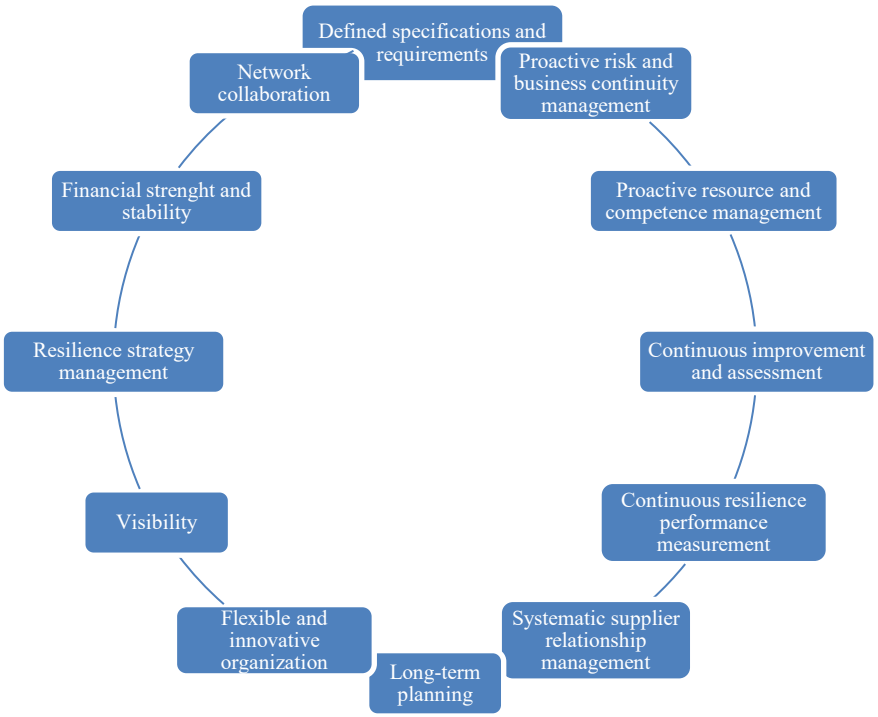


Figure 3. SCRes capabilities in the energy industry.

Systematic and proactive SRM needs to be implemented through whole SC to manage SCRes by interaction and capabilities development in buyer company and supplier roles. Well-structured and organized sourcing management has an essential role in creating SCRes supportive structure with resilience strategy, management models and implement practices for continuous interaction. Interaction between critical suppliers and buyer company need to be increased by HSEQ® assessments, development discussions and regular follow up meetings. More boost for development is achieved by network collaboration with NESA, HSEQ® cluster, LOGY and other energy industry companies. It is important to promote continuous improvement increase in SCRes and improve SCRes capabilities through for the whole SC to create standardized preparedness in every company. An agreement is one of the most important risk management tools when terms and conditions are covered comprehensively, and SOPIVA-clauses are used.

Business Continuity Plans need to be prepared following the updated BCP framework (Table 6) as a comprehensive and continuous process internally in companies and in collaboration with suppliers. BCP templates and checklists are implemented to suppliers

with instructions for BCP creation. Continuous collaboration and discussion need to be maintained with other companies in the energy industry and suppliers about SCRes development to identify risks and improve preparedness against a potential crisis.

There are several KPIs available in the companies which can be used to monitor SCRes. Measuring needs to be done supplier-specifically, and results are important to be analyzed in collaboration with suppliers. Monitoring enables risk identification in the early phase, development follow-up and success evaluation. Financial strength is an essential part of SCRes to decrease financial risks and thereby supplier finance needs to be monitored continuously 24/7 by an external service provider.

Internal and external collaboration, e.g with suppliers, other energy industry companies and NESA, is essential when building SCRes to consider how preparedness and SCRes can be improved. Collaboration and partnership-thinking are needed as they promote the development of SCRes. Business continuity management need to be done proactively in collaboration with suppliers. The BCPs need to be required from suppliers. It is essential to consider the BCP process (Table 6) completely and implement practical trainings and simulations with suppliers. Virtual simulation tools can be used if those are developed in the future. Visibility needs to be increased through the whole SC to increase the knowledge of SC and risk visibility.

In the energy industry several services are outsourced which highlights the importance of shared resource and competence planning with suppliers. As safety is one of the key issues in SCRes in the energy industry, there needs to be competent and qualified resources available in every situation. Innovative and flexible organizational culture needs to be built in collaboration with suppliers to promote proactivity, visibility and continuous improvement. It is created by information sharing, employee involvement, cross-competence increase and open culture.

HSEQ® cluster has a standardized model of operation to improve supplier quality. SCRes development in the companies can be promoted by improving collaboration with the HSEQ® cluster. Based on this research, there are SCRes critical capabilities that are considered inadequately in the current HSEQ® assessment form and PSK8404 standard. The HSEQ® assessment form could consider the availability and content of BCPs and agreements, resilience measurement, financial strength follow-up, visibility, resources, competences and SRM practices. The collaboration between the HSEQ® cluster and

NESA needs to be improved to develop detailed criteria for how to evaluate SCRes in HSEQ® assessments. PSK8404 standard could also consider similar topics.

The public tendering is seen as a challenge to collaboration and partnership development with suppliers and, thereby SCRes. The Act of Public Procurement and Concession Contract (139/2016) (Finlex 2021) and Act on Procurement and Concession Contracts licensing of entities operating in the water, energy, transport and postal service (1398/2016) (Finlex 2021) are limiting the lengths of the agreements. The procurement laws require regular tendering with equal opportunity for every supplier which is conflicting with building SCRes in collaboration with suppliers and partnerships development in the long term. The procurement law requirements and regular tendering can also be seen as an accelerator for continuous improvement for the supplier side when awareness about tendering prevents suppliers from keeping partnerships self-evident and motivates for development. In any case, continuous improvement benefits suppliers and the buyer company as it strengthens competitive advantage. Thereby continuous improvement and partnership-thinking need to be implemented with suppliers despite the short contract period or upcoming tendering while taking the requirements and specifications into account.

The regulations by laws are preventing supplier early involvement as all the suppliers need to be treated equally. Supplier early involvement benefits proactive quality improvement and innovations, which increase SCRes. It can be stated that there is a discrepancy between the targets of the laws and effects in the practice if laws are not well understood. Therefore, there needs to be legal competence in the company, or it needs to be bought from an external service provider to understand the laws comprehensively.

When considering the resilience strategy and sourcing, there are different statements about the sourcing strategy to build resilience. According to Mehrjerdi and Shafiee (2021), faster recovery from disruptions is enabled by decentralization and using multiple sourcing strategies. On the other hand, it is stated by Jain et al. (2021) that long-term partnerships enable faster recovery from disruptions. In the energy industry laws are restricting possibilities for multiple sourcing in some cases. Still, proactive planning for material shortages needs to be done in collaboration with contractual suppliers, and corrective actions need to be planned.

The role of inventories related to SCRes is contradictory. Inventories limit the flexibility, agility and adaptability in case of market changes (Sheffi 2021), and thereby decreasing SCRes e.g. from a financial perspective. In the energy industry the emergency inventories are necessary since those ensure the availability of spare parts. Even though there is change ongoing in the energy industry towards renewable energy, the speed of change is relatively slow, and inventories are not a risk for the financial resilience. Therefore, emergency inventory availability needs to be agreed upon with suppliers proactively for critical spare parts.

The results of this research have already been introduced to over 200 professionals in HSEQ virtual seminar organized by Kiwa Inspecta on 18th May 2021. The seminar program and presentation material are presented in Appendices 3 and 4. The findings of this research can be utilized for other industrial fields by the management of SCRes. As SCRes concerns several fields of industry, the same capabilities can be used to build SCRes in other fields of industry in addition to the energy industry.

# 6 CONCLUSION

This research provides knowledge and a review of how SCRes can be managed and developed by supplier relationship management. It is focusing on describing critical capabilities, management and improvement in the energy industry in Finland. SCRes definition in SC generally and in the energy industry and its management practices are presented as well. In energy industry SCRes is a critical part of strategic management due to its critical role in society and competitiveness. The critical capabilities of SCRes and the improvement of it were explored by interviews in six energy industry companies and National Emergency Security Agency. SCRes building requires clear requirements and specifications defined in internal collaboration. More proactivity, planning and internal and external collaboration are needed in risk preparedness and business continuity management. Systematic and proactive SRM is essential in SCRes capabilities management and improvement through whole SC to ensure uniform SCRes.

## 6.1 Key findings

The key findings based on literature review and empirical study are presented in this chapter regarding defined research questions.

**RQ1: How can SCRes be defined in an energy industry context?**

SCres is defined as a capability to tolerate crisis and to prepare proactively to ensure fast recovery in case of crisis, disruptions or changed circumstances. It is also the capability to adapt and develop actions to a new balance state after crisis, as well as the ability to identify potential problems proactively, monitor and ability to learn from faced crisis. Organizational and financial resilience are essential parts of SCRes. In the energy industry SCRes is defined as the capability to create diversity and connectivity but also as robustness and capability to keep up the performance in every situation.

**RQ2: How to manage SCRes?**

SCRes is an important strategic management tool and a part of business strategy to increase competitiveness and enable flexibility. It is managed throughout the whole SC on every business level collaboratively through systematic, proactive and planning-based

risk management. Disruptions are managed proactively by Business Continuity Management process including Business Continuity Plan, creating the basis for risk management in the company. Organizational culture is built to support change readiness, visibility and collaboration with partners. Financial resilience is managed by building profitability and supplier finance follow-up. SCRes KPI measurement ensures proactive risk management and continuous improvement. SC Resilience is managed by SCres capabilities in collaboration with suppliers.

**RQ3: What capabilities are critical to be considered to ensure high SCRes in the energy industry in Finland?**

SCRes consists of several critical capabilities which need to be developed in buyer the company and within suppliers throughout the whole SC. The capabilities are continuous improvement and assessment, continuous resilience performance measurement, defined specifications and requirements, financial strength, flexible and innovative organization, long-term planning, network collaboration, proactive resource and competence management, proactive risk and business continuity management, resilience strategy management, systematic supplier relationship management and visibility. These capabilities are presented in more detail in Figure 3.

**RQ4: How to improve SCRes in the energy industry in Finland?**

In the energy industry SCRes is improved through proactive, long-term business continuity management through the whole SC. SCRes improvement is promoted by systematic SRM. Continuous improvement and collaboration with the whole SC, critical suppliers, HSEQ® cluster, NESA, LOGY and other energy industry companies is essential to keep up continuous improvement and discussion of how to improve SCRes. Improvement is measured continuously by chosen KPIs based on company strategy to keep up the development.

## 6.2 Limitations and validity of the research

The research was implemented as qualitative research by one researcher which provides subjective results. The results may vary if the research is implemented by other researcher or several researchers. The interviews were implemented in energy industry companies

and critical capabilities were identified from their perspective. Energy industry suppliers or product design unit were not involved in the research and interviewing them could have given different answers and perspectives.

## 6.3 Future research

Similar research could also be explored also from suppliers´ or other stakeholders' perspectives, which would provide different results compared to this research. Other fields of the industry could also be researched if there are similarities between energy industry SCRes capabilities, management and improvement. The effects of procurement laws on supplier relationship management could be more explored. Also, different SCRes strategy effects could be considered if SCRes is created by decentralization or based on collaboration and what kind of differences there are between industrial fields.

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# 8 APPENDICES

Appendix 1. Interview questions for energy industry companies.

**A. Information of interviewee**

1. Name
2. Position and responsibility area
3. How long you have been working in this position?
4. Do you give permission to record the interview?
5. Do you give permission to use interview results in public thesis?

**B. Supply chain management**

6. What capabilities are critical to be considered in SC management to ensure high SCRes?
7. What elements weaken SCRes?
8. How to minimize failures proactively in energy production and distribution?
9. Have you defined and described the processes? How?
10. How you measure SCRes? What KPIs are used?
11. What development actions are planned to develop SCRes?

**C. Personnel management**

12. What capabilities are critical to be considered in personnel management to ensure high SCRes?
13. How personnel competence is maintained, developed and followed?
14. How you ensure adequate resources in normal and in emergency situations?
15. How personnel is involved to decision making and development?
16. How personnel participate to SC development?
17. What development actions are planned to be done in personnel management to develop SCRes?

**D. Continuity management**

18. What capabilities are critical to be considered in continuity management to ensure high SCRes?

19. Do you have a business continuity plan (BCP)?
20. How you measure business continuity? What KPIs are used?
21. What development actions are planned to be done in continuity management to develop SCRes?

**E. Risk management**

22. What capabilities are critical to be considered in risk management to ensure high SCRes?
23. How risk management is organized?
24. What SC risks are identified?
25. How have you prepared for realization of risks?
26. How risk effects are identified and evaluated?
27. How you measure risk management? What KPIs are used?
28. What development actions are planned to be done in risk management to develop SCRes?

**F. Asset management**

29. What capabilities are critical to be considered in asset management to ensure high SCRes
30. How condition of assets is taken care of?
31. What is required to promote long service life of assets?
32. How you measure asset management? What KPIs are used?
33. What development actions are planned to be done in asset management to develop SCRes?

**G. Safety**

34. What capabilities are critical to be considered in safety to ensure high SCRes?
35. How to improve SCRes by safety?
36. How you measure safety? What KPIs are used?
37. How is safety maintained?
38. What development actions are planned to be done in safety to develop SCRes?

**H. Supplier management, stakeholder collaboration and sourcing**

39. What capabilities are critical to be considered in supplier management, stakeholder collaboration and sourcing to ensure high SCRes?
40. Who are the most necessary partners?
41. How suppliers and stakeholders collaboration are managed?
42. What is the importance of partnerships in SCRes?
43. How SCRes is developed with suppliers and stakeholders?
44. How suppliers/stakeholders are prepared for risks?
45. How suppliers/stakeholders risk exposure is followed?
46. How sourcing is organized?
47. How you measure supplier and stakeholder management or sourcing? What KPIs are used?
48. What development actions are planned to be done in supplier and stakeholder management or sourcing to develop SCRes?

Appendix 2. Interview questions for National Emergency Security Agency.

1. What capabilities are critical to be considered and improved in the following areas to ensure high SCRes in the energy industry in Finland:
    a. in SC management?
    b. in risk management?
    c. in continuity management?
    d. in safety?
    e. in asset management?
    f. in supplier collaboration?
    g. in procurement?

2. How SCRes should be developed in energy industry in Finland?

3. How collaboration between energy industry and National Emergency Supply agency should developed?

Appendix 3. HSEQ virtual seminar program.

kiwa Palvelut Toimialat Koulutukset Ota yhteyttä

# Todenna toimituskykysi - kehitä kumppanuutta - paranna mahdollisuuksiasi!

**Tunnetko toimittajasi, tai oletko toimittajana toiselle yritykselle?**

Tutustu HSEQ -arviointeihin alan eri toimijoiden ja asiantuntijoiden kautta. Tehokkaassa kahden tunnin tapahtumatallenteesta saat vankan tietopaketin käyttöösi, olitpa sitten tilaaja, toimittaja tai asiasta muuten kiinnostunut toimija.

Tapahtuman puhujat, teemat ja aloitusaika tallenteessa:

00:00:00 Business Manager, Supplier Audits, **Kaj von Weissenberg, Kiwa Inspecta**

- HSEQ alustus

00:18:35 Business Unit Manager **Jari Leskinen, HELEN**

- HELENin vaatimukset kunnossapidon toimittajille
- Vastuullisuus HELENillä

00:33:45 Supplier Development Manager **TimoTaurén, Andritz**

- HSEQ:n hyödyt Andritzille tilaajana ja alihankkijana
- energiatehokkuus

00:49:30 QHSE Manager **Juha Malinen, Raumaster** ja Manager QMH **Tanja Ufer, Raumaster Paper**

- Kokemuksia HSEQ -arvioinnista
- vaikutukset toiminnan kehittämiseen

01:03:00 Diplomityöntekijä **Suvi Leinonen, Oulun Yliopisto**

- Toimitusketjun resilienssi

01:17:00 Kiwa Inspectan Pääarvioijat **Sini Ahlgren, Juha Karlsson ja Kaj von Weissenberg**

- Miten toimittajat ovat hyötyneet HSEQ -arvioinnista?
- Miksi arviointi maksaa ja miten se eroaa sertifioinnista?
- HSEQ -arviointiin ilmoittaudutaan?
- Itsearviointi, mikä se on ja voiko sen ottaa erikseen?
- Haluaisin vain itsearvioinnin, voiko sen todentaa kevyesti?
- Jos otan vain palan kerrallaan, tuleeko siitä ylimääräisiä kuluja?

Tapahtuman juontaa Kiwa Inspectan asiakkuuspäällikkö **Timo Halttula**.

Appendix 4. HSEQ virtual seminar presentation material.

31.5.2021

# Toimitusketjun resilienssi

**Todenna toimituskykysi – kehitä kumppanuutta – paranna mahdollisuuksiasi 18.5.2021**

**Suvi Leinonen**
**Diplomityöntekijä, tuotantotalous**



1

## Sisältö

- Tutkimuksen esittely
- Toimitusketjun resilienssi käsitteenä
- Toimitusketjun resilienssin merkitys
- Toimitusketjun resilienssiä kehittäviä kyvykkyyksiä



2

## Tutkimuksen esittely

- Diplomityön aihe: Alihankkijoiden resilienssiarviointi energiateollisuudessa
- Laaja kv. kirjallisuuskatsaus
- Laaja haastattelututkimus
  - 19 haastattelua, yhteensä 28 haastattelutuntia
- Haastatellut yritykset
  - 6 energia-alan HSEQ-tilaajayritystä ja Huoltovarmuuskeskus



3

## Toimitusketjun resilienssi käsitteenä

- Kykyä sietää kriisejä tai häiriöitä ja palautua niistä nopeasti
- Kykyä mukautua uuteen normaaliin kriisien, häiriöiden tai muuttuvien olosuhteiden johdosta
- Kykyä vastata muutoksiin
- Kykyä valvoa ja tunnistaa proaktiivisesti potentiaalisia ongelmia sekä oppia niistä



4

## Toimitusketjun resilienssin merkitys

- Yritysten toimitusketjun resilienssi vaihtelee, miten kriiseihin on varauduttu tai miten kriisinkestäviä yritykset ovat → Paljon kehitettävää Suomessa.
- Toimitusketjun resilienssi on tärkeä kilpailukyvyn tekijä → huomioitava ja johdettava koko toimitusketjussa ja organisaatiotasoilla.
- Oleellista proaktiivinen riskienhallinta ja liiketoiminnan jatkuvuuden turvaaminen → häiriöiden vaikutusten minimointi toimitusketjun suorituskykyyn
- Kriisien täydellinen ennakointi tai estäminen mahdotonta → yritysten sisäiset ja yritysten väliset kyvykkyydet mahdollistavat nopean palautumisen kriisin tai häiriön jälkeen.



5

## Toimitusketjun resilienssiä kehittäviä kyvykkyyksiä

- **Vaatimusten ja tarpeiden määrittely**
- **Proaktiivinen riskeihin varautuminen ja liiketoiminnan jatkuvuussuunnittelu**
- **Systemaattinen toimittajasuhteiden johtaminen**
- Jatkuva parantaminen ja arviointi
- Proaktiivinen resurssien ja osaamisen johtaminen
- Joustava ja innovatiivinen organisaatio
- Taloudellinen vakaus ja vahvuus
- Läpinäkyvyys
- Resilienssistrategia
- Verkostoyhteistyö
- Pitkän tähtäimen suunnittelu



6

## Vaatimusten ja tarpeiden määrittely

- Lähtökohta laadukkaalle hankintaprosessille
- Esim. tekniset vaatimukset, osaamis- ja pätevyysvaatimukset, lakivaatimukset, varautumissuunnitelmavaatimukset
- Sisäinen yhteistyö → tarpeiden mukaiset vaatimukset
- Vaatimusten kirjaaminen sopimuksiin



7

## Proaktiivinen riskeihin varautuminen ja liiketoiminnan jatkuvuussuunnittelu

- Esim. riskien tunnistaminen, palautumissuunnitelmat ja yhteiset käytännön harjoitukset toimittajien kanssa
- Yrityksien sisäiset pitkän tähtäimen suunnitelmat
- Lisäksi suunnitteluyhteistyö: toimittajat ja muut alan yritykset
- Suunnitelmat vaadittava toimittajilta toimitusketjun alkupäästä saakka→ yhtenäinen varautuminen
- Riskien tunnistaminen → jatkuva parantaminen → toimittajien arviointi ja kehitys
- Verkostoyhteistyö
  - HSEQ klusteri: toimittaja-arvioinnit
  - Huoltovarmuuskeskus: varautumissuunnitelmapohjat



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## Systemaattinen ja proaktiivinen toimittajasuhteiden johtaminen

- Esim. kriittisten toimittajien tunnistaminen, yhtenäiset toimittajien johtamismallit, vaatimusten kommunikointi toimittajalle sekä jatkuva yhteistyö ja vuorovaikutus, kumppanuus
- Toimittajien johtaminen
- Edistää kyvykkyyksien kehittymistä, jatkuvaa parantamista ja kumppanuutta



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## Lisätietoa aiheesta

- Koko diplomityö luettavissa julkisena 15.6.2021 jälkeen
- Linkki työhön löytyy sivulta www.hseq.fi → Lisätietoa → HSEQ julkisuudessa: https://www.hseq.fi/index.php?p=HSEQjulkisuudessa
- Jos kysyttävää, ota yhteyttä: suvi.e.leinonen@gmail.com

KIITOS!



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Appendix 5. SCRes capabilities in energy industry.

| SCRES CAPABILITY | INTRAORGANIZATIONAL | INTERORGANIZATIONAL |
|---|---|---|
| Defined specifications and requirements | - Business unit needs<br>- Laws<br>- Competences, quality<br>- Safety<br>- Security<br>- Risk and continuity planning<br>- Data management<br>- Communication to suppliers<br>- Documentation to agreements<br>- Internal collaboration<br>- Long-term planning | |
| Proactive risk and business continuity management | - Proactive, predictive planning<br>- Company specific crisis committee<br>- Combined risk and business continuity plan:<br>o Risk identification<br>o Mitigation plans<br>o Effect evaluation<br>o Management and communication models<br>o Disaster Recovery Plan<br>o Employee trainings<br>o Practical trainings and simulations<br>o NESA template for BCP<br>o Internal collaboration | - Proactive, predictive business continuity planning through whole SC.<br>- Risk scenario and plan creation<br>- Risk identification and continuous evaluation from beginning of SC<br>- Common risk preparedness trainings and simulations<br>- National crisis committee |
| Proactive resource and competence management | - Identified company-specific competence and resource needs, critical competences and key tasks.<br>- Resource planning<br>- Orientaiton plans<br>- Cross-competence increase<br>- Defined future competence needs<br>- Competence development and qualification follow up system | - Resource availability planning<br>- Competence and qualification management<br>- Orientaiton plans<br>- Cross-competence increase<br>- Defined future competence needs<br>- Competence development and qualification follow up system<br>- Competence developmet with network |
| Continuous improvement and assessments | - Continuous improvement in daily actions<br>- Proactive risk identification and observations, root cause analysis, corrective actions, monitoring,<br>- Employee involvement to development projects and teams (LOGY, NESA)<br>- Supplier audit model, audit plan and competence development<br>- HSEQ assessments<br>- Reclamation process | - Development teams<br>- Development workshops<br>- Proactive risk identification, observations and feedback<br>- HSEQ supplier audits<br>- Best practise sharing<br>- Supplier early involvement |
| Continuous resilience performance measurement | - KPIs chosen based on the strategy<br>- Supplier-specific measurements<br>o Liability<br>o Additional costs<br>o Defects<br>o Recovery times<br>o Supplier quality<br>o Supplier scorecard<br>o Financial situation<br>o Service lead time<br>o SLA conformity<br>o Supplier satisfaction | - Continuous KPI measurement, results analysis |
| Systematic SRM | - Defined sourcing alignments:<br>o Supplier quality criteria<br>o Supplier classification and prioritization<br>o Management models<br>o Tendering criteria<br>o Applications of laws<br>o Annual supplier management plan<br>- Comprehensive agreements | - Partnerships development<br>- Continuous interaction and communication<br>- Common business practices and targets<br>- Defined roles and resposbilities<br>- Meetings montly /quaterly<br>- Development discussions<br>- Common trainings<br>- Common SRM tool<br>- Active supplier collaboration |

| | | |
|---|---|---|
| | ○ Specifications and requirements<br>○ Used KPIS and target levels<br>○ Incentives SOPIVA-clauses<br>○ Management related issues<br>○ Terms and conditions | - Supplier assessment<br>- Mutual trust and open discussion<br>- Feedback<br>- Common material and service availability planning<br>- Back-up plans for material flow<br>- Emergency inventories |
| Long-term planning | - Based on the ERP data<br>- Long-term planning, anticipation and implementation of plans<br>- In SRM, business continuity, finance, resource and competence management | - Proactive planning anticipation and implementation<br>- Resiliience strategy creation |
| Flexible and innovative organization | - Multiskilled, cross-competent employees,<br>- Open culture<br>- Employee involvement to strategic work<br>- Clear instructions<br>- Innovativeness<br>- Information sharing<br>- Agility to react<br>- Adaptability | - Multiskilled, cross-competent employees,<br>- Open culture<br>- Knowledgeand information sharing<br>- Clear instructions<br>- Innovativeness<br>- Agility to react<br>- Adaptability |
| Visibility | - Proactive information sharing, communication interaction<br>- Process descriptions<br>- Instructions and operating models<br>- Clear roles and responsibilities<br>- Documentation<br>- ERP and SRM systems | - Proactive information sharing, communication interaction<br>- Process descriptions<br>- Instructions and operating models<br>- Clear roles and responsibilities<br>- Documentation<br>- ERP and shared SRM systems |
| Resilient strategic management | - Part of business strategy<br>- Considered already in NPD-phase as standardized product and various suppliers<br>- Enables agility and flexibility | |
| Financial stability and strenght | - Supplier selection criteria<br>- 24/7 follow up during whole contractual lifecycle | - Optimal cash flow through whole SC |
| Network collaboration | - Internal collaboration | - Solution-oriented collaboration<br>- Partnerships<br>- Trust<br>- Development and innovations<br>- Competence and resource planning<br>- Continuous improvement<br>- Proactive risk and business continuity management<br>- Other energy companies<br>- HSEQ® cluster<br>- NESA pools<br>- LOGY |